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PTO/SB/05 (1/98)
Approved for use through 09/30/2000. OMB 0651-0032
Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	18
First Inventor or Application Identifier	Eduardo J. Moura
Title	ASYMMETRIC HYBRID ACCESS SYSTEM AND METHOD
Express Mail Label No	

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents

ADDRESS TO Assistant Commissioner for Patents
Box Patent Application
Washington, DC 20231

1. [X] * Fee Transmittal Form *(e.g., PTO/SB/17)*
   (Submit an original, and a duplicate for fee processing)
2. [X] Specification [*Total Pages* 43]
   (preferred arrangement set forth below)
   - Descriptive title of the Invention
   - Cross References to Related Applications
   - Statement Regarding Fed sponsored R & D
   - Reference to Microfiche Appendix
   - Background of the Invention
   - Brief Summary of the Invention
   - Brief Description of the Drawings *(if filed)*
   - Detailed Description
   - Claim(s)
   - Abstract of the Disclosure
3. [X] Drawing(s) *(35 U.S.C. 113)* [*Total Sheets* 20]
4. Oath or Declaration [*Total Pages* 1]
   a. [ ] Newly executed (original or copy)
   b. [X] Copy from a prior application (37 C.F.R. § 1.63(d))
      (for continuation/divisional with Box 17 completed)
      [Note Box 5 below]
      i. [X] DELETION OF INVENTOR(S)
         Signed statement attached deleting inventor(s) named in the prior application, see 37 C.F.R. §§ 1.63(d)(2) and 1.33(b).
5. [X] Incorporation By Reference *(useable if Box 4b is checked)*
   The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered to be part of the disclosure of the accompanying application and is hereby incorporated by reference therein.
6. [ ] Microfiche Computer Program *(Appendix)*
7. Nucleotide and/or Amino Acid Sequence Submission
   (if applicable, all necessary)
   a. [ ] Computer Readable Copy
   b. [ ] Paper Copy (identical to computer copy)
   c. [ ] Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

8. [ ] Assignment Papers (cover sheet & document(s))
9. [ ] 37 C.F.R.§3.73(b) Statement *(when there is an assignee)* [ ] Power of Attorney
10. [ ] English Translation Document *(if applicable)*
11. [ ] Information Disclosure Statement (IDS)/PTO-1449 [ ] Copies of IDS Citations
12. [X] Preliminary Amendment
13. [X] Return Receipt Postcard (MPEP 503)
    (Should be specifically itemized)
14. [ ] * Small Entity Statement(s) *(PTO/SB/09-12)* [ ] Statement filed in prior application, Status still proper and desired
15. [ ] Certified Copy of Priority Document(s)
    (if foreign priority is claimed)
16. [ ] Other: ....

** A new statement is required to be entitled to pay small entity fees, except where one has been filed in a prior application and is being relied upon.*

17. **If a CONTINUING APPLICATION,** *check appropriate box, and supply the requisite information below and in a preliminary amendment:*

[X] Continuation [ ] Divisional [ ] Continuation-in-part (CIP) of prior application No. 08 / 703,767

Prior application information: Examiner Shick Hom *Group / Art Unit:* 2732

18. CORRESPONDENCE ADDRESS

[ ] *Customer Number or Bar Code Label* (Insert Customer No. or Attach bar code label here) or [X] *Correspondence address below*

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Name (Print/Type)	Jerome D. Jackson	*Registration No. (Attorney/Agent)*	33,186
Signature	Jerome D. Jackson	*Date*	12/17/98

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FEE TRANSMITTAL

Patent fees are subject to annual revision on October 1
These are the fees effective October 1, 1997
Small Entity payments must be supported by a small entity statement, otherwise large entity fees must be paid See Forms PTO/SB/09-12
See 37 C F R §§ 1 27 and 1 28

TOTAL AMOUNT OF PAYMENT ($) 1,606

Complete if Known	
Application Number	
Filing Date	
First Named Inventor	Eduardo J. Moura
Examiner Name	
Group / Art Unit	
Attorney Docket No	18

METHOD OF PAYMENT (check one)

1. [X] The Commissioner is hereby authorized to charge indicated fees and credit any over payments to

Deposit Account Number: 06-0115

Deposit Account Name: Kile, McIntyre & Harbin

[X] Charge Any Additional Fee Required Under 37 C F R §§ 1 16 and 1 17

[ ] Charge the Issue Fee Set in 37 C F R § 1 18 at the Mailing of the Notice of Allowance

2. [X] **Payment Enclosed:**

[X] Check [ ] Money Order [ ] Other

FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
101	790	201	395	Utility filing fee	760
106	330	206	165	Design filing fee	
107	540	207	270	Plant filing fee	
108	790	208	395	Reissue filing fee	
114	150	214	75	Provisional filing fee	

SUBTOTAL (1) ($) 760

2. EXTRA CLAIM FEES

			Extra Claims		Fee from below		Fee Paid
Total Claims	41	-20** =	21	X	18	=	378
Independent Claims	9	- 3** =	6	X	78	=	468
Multiple Dependent						=	

**or number previously paid, if greater; For Reissues, see below

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
103	22	203	11	Claims in excess of 20
102	82	202	41	Independent claims in excess of 3
104	270	204	135	Multiple dependent claim, if not paid
109	82	209	41	** Reissue independent claims over original patent
110	22	210	11	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($) 846

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
105	130	205	65	Surcharge - late filing fee or oath	
127	50	227	25	Surcharge - late provisional filing fee or cover sheet	
139	130	139	130	Non-English specification	
147	2,520	147	2,520	For filing a request for reexamination	
112	920*	112	920*	Requesting publication of SIR prior to Examiner action	
113	1,840*	113	1,840*	Requesting publication of SIR after Examiner action	
115	110	215	55	Extension for reply within first month	
116	400	216	200	Extension for reply within second month	
117	950	217	475	Extension for reply within third month	
118	1,510	218	755	Extension for reply within fourth month	
128	2,060	228	1,030	Extension for reply within fifth month	
119	310	219	155	Notice of Appeal	
120	310	220	155	Filing a brief in support of an appeal	
121	270	221	135	Request for oral hearing	
138	1,510	138	1,510	Petition to institute a public use proceeding	
140	110	240	55	Petition to revive - unavoidable	
141	1,320	241	660	Petition to revive - unintentional	
142	1,320	242	660	Utility issue fee (or reissue)	
143	450	243	225	Design issue fee	
144	670	244	335	Plant issue fee	
122	130	122	130	Petitions to the Commissioner	
123	50	123	50	Petitions related to provisional applications	
126	240	126	240	Submission of Information Disclosure Stmt	
581	40	581	40	Recording each patent assignment per property (times number of properties)	
146	790	246	395	Filing a submission after final rejection (37 CFR 1 129(a))	
149	790	249	395	For each additional invention to be examined (37 CFR 1 129(b))	

Other fee (specify) ____________________

Other fee (specify) ____________________

* Reduced by Basic Filing Fee Paid

SUBTOTAL (3) ($)

SUBMITTED BY

				Complete (if applicable)	
Typed or Printed Name	Jerome D. Jackson			Reg. Number	33,186
Signature	Jerome D. Jackson	Date	12/17/98	Deposit Account User ID	

Burden Hour Statement This form is estimated to take 0 2 hours to complete Time will vary depending upon the needs of the individual case Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231 DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS SEND TO Assistant Commissioner for Patents, Washington, DC 20231

PATENT
ATTORNEY DOCKET No. 27459-803/767

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of: MOURA, Eduardo J.;)
Gronski, Jan M. ; and)
Enns, Frederick)
)
Filed: Herewith)
)
Continuation of)
Serial No.: 08/703,767)
Filed : August 27, 1996)
)
For: ASYMMETRIC COMMUNICATION)
SYSTEM WITH REGULATED)
UPSTREAM CHANNEL)
(as amended))

Honorable Commissioner of Patents
and Trademarks
Washington, D.C. 20231

Sir:

PRELIMINARY AMENDMENT

Before examination of this Application, please amend the Application as follows:

IN THE TITLE:

Please change the title to –ASYMMETRIC COMMUNICATION SYSTEM WITH REGULATED UPSTREAM CHANNEL–.

IN THE SPECIFICATION:

Page 2, line 9, change "paths" to –channels–; and

line 20, change "narrow" to –narrower–.

Page 13, line 13, change "5" to –26–; and

line 20, change "5" to –26–.

IN THE CLAIMS:

Please cancel claims 1-20 and 22-25 without prejudice or disclaimer, and add the following new claims:

--26. A two way asymmetric network communication system for transferring data between a server and a plurality of remote devices for supporting server-client communication, the communication system comprising:

a plurality of remote interfaces associated with respective remote devices;

a downstream channel in a direct broadcast satellite network, a CATV network, or an over-the-air radio frequency transmission;

an upstream channel in a CATV network, or an over-the-air radio frequency transmission;

a control system acting to generate, for each remote interface, a respective signal that determines an amount that the remote interface may send during a certain period,

wherein each remote interface includes

a receiver that receives downstream data from the server over the downstream channel, and provides the data to the associated remote device; and

a sender that sends, during the certain period, data from the associated remote device over the upstream channel, an amount of the sent data being governed by the respective signal.

27. The communication system of claim 26 wherein, for each remote interface, the control system generates the respective signal for each activation of the sender in the remote interface.

28. The communication system of claim 26 wherein the control system includes a sender that sends a credit to the remote interface.

29. The communication system of claim 26 wherein the control system includes logic to make the certain period of each remote interface different from the certain period of the other remote interfaces

30. The communication system of claim 29 wherein the control system includes logic to make certain period of a remote interface mutually exclusive of the certain period of the other remote interfaces.

31. A two way asymmetric network communication system for transferring data between a server and a plurality of remote devices for supporting server-client communication, each remote device running a layered communication protocol, the communication system comprising:

a plurality of remote interfaces associated with respective remote devices;

a downstream channel in a direct broadcast satellite network, a CATV network, or an over-the-air radio frequency transmission;

an upstream channel in a CATV network, or an over-the-air radio frequency transmission;

a control system acting to generate, for each remote interface, a respective signal that determines an amount that the remote interface may send during a certain period,

wherein each remote interface includes

a receiver that receives downstream data from the server over the downstream channel, and provides the data to the associated remote device, such that the downstream channel is transparent to the associated remote device; and

a sender that sends, during the certain period, data from the associated remote device over the upstream channel, such that the upstream channel is transparent to the associated remote device, an amount of the sent data being governed by the respective signal.

32. The communication system of claim 31 wherein, for each remote interface, the control system generates the respective signal for each activation of the sender in the remote interface.

33. The communication system of claim 31 wherein the control system includes a sender that sends a credit to the remote interface.

34. The communication system of claim 31 wherein the control system includes logic to make the certain period of each remote interface different from the certain period of the other remote interfaces

35. The communication system of claim 31 wherein the control system includes logic to make certain period of a remote interface mutually exclusive of the certain period of the other remote interfaces.

36. A two way asymmetric network communication system for transferring data between a server and a plurality of remote devices for supporting server-client communication, the communication system comprising:

a plurality of remote interfaces associated with respective remote devices;

a downstream channel in a direct broadcast satellite network, a CATV network, or an over-the-air radio frequency transmission;

an upstream channel in a CATV network, or an over-the-air radio frequency transmission;

a control system, common to the downstream and upstream channels, the control system acting to generate, for each remote interface, a respective signal that determines an amount that the remote interface may send during a certain period,

wherein each remote interface includes

a receiver that receives downstream data from the server over the downstream channel, and provides the data to the associated remote device; and

a sender that sends, during the certain period, data from the associated remote device over the upstream channel, an amount of the sent data being governed by the respective signal.

37. The communication system of claim 36 wherein, for each remote interface, the control system generates the respective signal for each activation of the sender in the remote interface.

38. The communication system of claim 36 wherein the control system includes a sender that sends a credit to the remote interface.

39. The communication system of claim 36 wherein the control system includes logic to make the certain period of each remote interface different from the certain period of the other remote interfaces

40. The communication system of claim 36 wherein the control system includes logic to make certain period of a remote interface mutually exclusive of the certain period of the other remote interfaces.

41. A two way asymmetric network communication system for transferring data between a server and a plurality of remote devices for supporting server-client communication, each remote device running a layered communication protocol, the communication system comprising:

a plurality of remote interfaces associated with respective remote devices;

a downstream channel in a direct broadcast satellite network, a CATV network, or an over-the-air radio frequency transmission;

an upstream channel in a CATV network, or an over-the-air radio frequency transmission;

a control system, common to the downstream and upstream channels, the control system acting to generate, for each remote interface, a respective signal that determines an amount that the remote interface may send during a certain period,

wherein each remote interface includes

a receiver that receives downstream data from the server over the downstream channel, and provides the data to the associated remote device, such that the downstream channel is transparent to the associated remote device; and

a sender that sends, during the certain period, data from the associated remote device over the upstream channel, such that the upstream channel is transparent to the associated remote device, an amount of the sent data being governed by the respective signal.

42. The communication system of claim 41 wherein, for each remote interface, the control system generates the respective signal for each activation of the sender in the remote interface.

43. The communication system of claim 41 wherein the control system includes a sender that sends a credit to the remote interface.

44. The communication system of claim 41 wherein the control system includes logic to make the certain period of each remote interface different from the certain period of the other remote interfaces

45. The communication system of claim 41 wherein the control system includes logic to make certain period of a remote interface mutually exclusive of the certain period of the other remote interfaces.

46. A method of operating a two way asymmetric network communication system for transferring data between a server and a plurality of remote devices for supporting server-client communication, the communication system including a plurality of remote interfaces associated with respective remote devices, a downstream channel in a direct broadcast satellite network, a CATV network, or an over-the-air radio frequency transmission, an upstream channel in a CATV network, or an over-the-air radio frequency transmission, the method comprising:

generating, for each remote interface, a respective signal that determines an amount that the remote interface may send during a certain period, and

the following steps, performed by each remote interface, of

receiving downstream data from the server over the downstream channel, and providing the data to the associated remote; and

sending, during the certain period, data from the associated remote device over the upstream channel, an amount of the sent data being governed by the respective signal.

47. The method of claim 46 wherein, for each remote interface, the generating step is performed for each performance of the sending step.

48. The method of claim 46 wherein the certain period for a remote interface corresponds to a time between sending a credit to the remote interface and receiving another signal indicating that the remote device has completed a set of transmissions.

49. The method of claim 46 wherein the certain period of each remote interface is different from the certain period of the other remote interfaces

50. The method of claim 46 wherein the certain period of a remote interface is mutually exclusive of the certain period of the other remote interfaces.

51. A method of operating a two way asymmetric network communication system for transferring data between a server and a plurality of remote devices for supporting server-client communication, each remote device running a layered communication protocol, the communication system including a plurality of remote interfaces associated with respective

remote devices, a downstream channel in a direct broadcast satellite network, a CATV network, or an over-the-air radio frequency transmission, an upstream channel in a CATV network, or an over-the-air radio frequency transmission, the method comprising:

generating, for each remote interface, a respective signal that determines an amount that the remote interface may send during a certain period, and

the following steps, performed by each remote interface, of

receiving downstream data from the server over the downstream channel, and providing the data to the associated remote device, such that the downstream channel is transparent to the associated remote device; and

sending, during the certain period, data from the associated remote device over the upstream channel, such that the upstream channel is transparent to the associated remote device, an amount of the sent data being governed by the respective signal.

52. The method of claim 51 wherein, for each remote interface, the generating step is performed for each performance of the sending step.

53. The method of claim 51 wherein the certain period for a remote interface corresponds to a time between sending a credit to the remote interface and receiving another signal indicating that the remote device has completed a set of transmissions.

54. The method of claim 51 wherein the certain period of each remote interface is different from the certain period of the other remote interfaces

55. The method of claim 51 wherein the certain period of a remote interface is mutually exclusive of the certain period of the other remote interfaces.

56. A method of operating a two way asymmetric network communication system for transferring data between a server and a plurality of remote devices for supporting server-client communication, the communication system including a plurality of remote interfaces associated with respective remote devices, a downstream channel in a direct broadcast satellite network, a CATV network, or an over-the-air radio frequency transmission, an upstream channel in a CATV network, or an over-the-air radio frequency transmission, and a control system common to the downstream and upstream channels, the method comprising the step, performed by the control system, of

generating, for each remote interface, a respective signal that determines an amount that the remote interface may send during a certain period, and

the following steps, performed by each remote interface, of

receiving downstream data from the server over the downstream channel, and providing the data to the associated remote device; and

sending, during the certain period, data from the associated remote device over the upstream channel, an amount of the sent data being governed by the respective signal.

57. The method of claim 56 wherein, for each remote interface, the generating step is performed for each performance of the sending step.

58. The method of claim 56 wherein the certain period for a remote interface corresponds to a time between sending a credit to the remote interface and receiving another signal indicating that the remote device has completed a set of transmissions.

59. The method of claim 56 wherein the certain period of each remote interface is different from the certain period of the other remote interfaces

60. The method of claim 56 wherein the certain period of a remote interface is mutually exclusive of the certain period of the other remote interfaces.

61. A method of operating a two way asymmetric network communication system for transferring data between a server and a plurality of remote devices for supporting server-client communication, each remote device running a layered communication protocol, the communication system including a plurality of remote interfaces associated with respective

remote devices, a downstream channel in a direct broadcast satellite network, a CATV network, or an over-the-air radio frequency transmission, an upstream channel in a CATV network, or an over-the-air radio frequency transmission, and a control system common to the downstream and upstream channels, the method comprising the step, performed by the control system, of

generating, for each remote interface, a respective signal that determines an amount that the remote interface may send during a certain period, and

the following steps, performed by each remote interface, of

receiving downstream data from the server over the downstream channel, and providing the data to the associated remote device, such that the downstream channel is transparent to the associated remote device; and

sending, during the certain period, data from the associated remote device over the upstream channel, such that the upstream channel is transparent to the associated remote device, an amount of the sent data being governed by the respective signal.

62. The method of claim 61 wherein, for each remote interface, the generating step is performed for each performance of the sending step.

63. The method of claim 61 wherein the certain period for a remote interface corresponds to a time between sending a credit to the remote interface and receiving another signal indicating that the remote device has completed a set of transmissions.

64. The method of claim 61 wherein the certain period of each remote interface is different from the certain period of the other remote interfaces

65. The method of claim 61 wherein the certain period of a remote interface is mutually exclusive of the certain period of the other remote interfaces.--

REMARKS

Claims 21 and 26-65 will be pending in this application after the Examiner enters the forgoing amendment.

The specification corresponds to the originally filed specification and amendments in allowed Parent Application Serial No. 08/703,767

Support for "a respective signal that determines an amount that the remote interface may send during a certain period" (claims 26, 31, 36, 41, 46, 51, 56, and 61) may be found, for example, in the credit that governs an amount of data an RLA may send during the period the

RLA possesses the credit. Support for the "different" certain period (claims 29, 34, 39, 44, 49, 54, 59, and 64) and for the "mutually exclusive" certain period (claims 30, 35, 40, 45, 50, 55, 60, and 65) is that a single RLA per channel possesses the credit at a time. Support for a system that "generates the respective signal for each activation of the sender" (claims 27, 32, 37, and 42) and for the act of generating "performed for each performance of the sending step" (claims 47, 52, 57, and 62) is that after an RLA exhausts a credit, sending of an additional credit is a prerequisite to the RLA sending more data. See, for example, page 6, lines 10-12:

> [A]n upstream channel is shared by a plurality of RLAs in accordance with a credit criterion, and credit control packets are dispatched to a RLA which permit the RLA to send data packets to arbitrary hosts.

and page 32 line 10-page 33, line 12:

> A credit permits a remote link adapter to send a certain number of packets. . . If a remote link adapter does not have a data packet to send, it returns the credit. . .
>
> Figure 18 is a flow diagram of information exchanges between Hybridware™ server and client, according to conditions in which the client has information to transmit and the server gradually allocates bandwidth to the client. In particular, a node first provides a single credit at a selected frequency F. Then a packet is sent, consuming the credit, followed by a completion message. . . Next, a credit is provided corresponding to two packets at the selected frequency F, which is followed by two packet transmissions and a completion message. . . In response, another double credit is sent. . .

Although the "certain period" corresponds to the interval an RLA possesses the credit, of course, the claims are not so limited. For example, the "certain period" may correspond to a cycle in a slotted time domain multiplexing (TDM) system, in which each remote interface has knowledge of the respective slot(s) in which the interface may send during a cycle. In that case,

the number of slots per cycle governs the amount of data the interface may send during a certain TDM cycle. In that case, the certain period of each interface is the same. In that case, the act of sending may be performed multiple times per performance of the generating step, since each interface may retain knowledge of its assigned slots through many TDM cycles.

Support for a "remote device" running a "layered communication protocol" (claims 31, 41, 51, and 61) may be found in the data terminal equipment or computer described on page 12, lines 19-23: "U.S. Pat. No. 5,347,304 (1994) assigned to Hybrid Networks, Inc., and describing an example of an RLA [remote link adapter] is hereby expressly referenced and incorporated herein in its entirety. An RLA may receive analog broadcast signals including encoded digital information which the RLA decodes and provides to a data terminal or computer." U.S. Pat. No. 5,347,304, col. 3, lines 17-18, discloses, "the RLA presents the resulting digital signal to the data terminal equipment (DTE) interface" and col. 6, lines 57-60, disclose, "[e]rror recovery is achieved by the end-to-end transport layer protocol running in the data terminal equipment (DTE). A good example here is TCP/IP."

Support for "transparent to the associated remote device" (claims 31, 41, 51, and 61) may be found on page 22, lines 6-7: ". . . channel reassignments are done transparently to the user and the applications," and on U.S. Pat. No. 5,347,304, col. 5, lines 46-56: ". . . a link layer connection is established between the central site [data communications equipment] and the remote RLA. This connection remains transparent to the applications running above. The hybrid connection looks like a transparent remote Ethernet bridge and, therefore, is compatible with all

upper layer protocols (e.g., TCP/IP, AppleTalk, ISO, DECNET, etc.) that can run over Ethernet. Once the connection is established, the remote user can now run standard network applications just as if the user were located at the central site local area network."

Applicants submit that the forgoing amendment places the application in better condition for examination. Applicants respectfully request that the forgoing amendment be entered before the examination of this application.

If there are any other fees due, please charge such fees to Deposit Account No. 06-0115.

Respectfully submitted,

By Jerome D. Jackson

Jerome D. Jackson
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12/17/98
DATE

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ASYMMETRIC HYBRID ACCESS SYSTEM AND METHOD

Field of Invention

This invention relates to systems and methods for extending a high-speed network to remote locations using an asymmetric hybrid access system.

Background of the Invention

Current data communication systems typically use symmetric communication paths between transmit and receive sites, which have substantially the same data rates and use the same media in both directions. Such media may include coaxial, fiber optic, or telephone twisted-pair lines. Some networks alternatively use broadcast only paths. However, no current network combines the flexibility of full-duplex symmetric networks with the cost effectiveness of broadcast only networks.

Prior attempts at achieving asymmetric data communications included modems with very low speed return channels or systems combining a low speed broadcast channel with telephone return lines. However, no prior systems were able to extend a symmetric high-speed backbone network to remote locations at high speeds using an asymmetric hybrid access system. Known prior asymmetric systems are limited to low speed links.

It is desirable to develop a network which combines the flexibility of a full-duplex network with the effectiveness of a broadcast network at a reasonable cost.

Summary of the Invention

According to the present invention, a high speed backbone network is extended for communications with remote locations with a hybrid asymmetric architecture having fully interactive duplex characteristics and including independent upstream and downstream communication paths operable at separately selectable speeds and protocols. According to one embodiment of the present invention, the hybrid asymmetric architecture includes 6 Megahertz television channels downstream and telephone lines for upstream communications. Alternative downstream communications can be accomplished according to the invention with a selected high bandwidth broadband service, including for example high definition television (HDTV). Downstream communications according to another embodiment can be implemented with a selected low cost, high speed broadband modem. Downstream communications can provide access to data from information sources including companies, government agencies, universities, libraries, and the like. Alternative upstream communications can be accomplished by a narrow band cable TV return channel, ISDN, radio, or a selected low-cost, low to medium speed telephone modem. The asymmetric hybrid system according to the present invention includes an interface with the backbone network connected to selected information sources. The interface includes point of presence (POP) circuits implementing high speed

downstream communications with lower speed upstream communications. The interface connects the backbone network with cable TV head ends, TV transmitters, cell sites, remote users, and upstream and downstream channels.

The present invention further includes a hybrid access configuration which uses both downstream and upstream channels. The present invention further includes a hybrid access configuration which uses downstream wireless TV channels and upstream public switch telephone network (PSTN), wireless RF communications or integrated services digital network (ISDN) telephone lines. The present invention further includes a hybrid access configuration which uses both downstream and upstream cable TV channels. The present invention further includes a hybrid access configuration which has downstream satellite TV channels and upstream public switch telephone network (PSTN), wireless RF communications, or integrated services digital network (ISDN) telephone lines.

The present invention further includes packet and acknowledge suppression methods to eliminate redundant packet, byte, and acknowledge transmissions in a hybrid access system. A packet is defined as an information unit containing one or more bytes of information. Particularly according to the method of the present invention, a certain amount or number of data packets or bytes are enqueued or transmitted in a transmit-ahead window. Transmission of a window of bytes or packets is followed by a predetermined time-out period while the transmit queue awaits acknowledgments of packets received. To the extent receipt acknowledgments are received as to particular bytes or packets, these

packets and bytes in the transmit queue will be deleted from the transmit queue, and the transmit queue is open to receipt of further packets or bytes for emplacement in slots of the transmission queue for the deletions made. With respect to acknowledgments placed in a transmission queue, indications acknowledging receipt of later bytes and packets supersede acknowledgments of earlier transmitted bytes or packets. Accordingly, under the present invention, the earlier acknowledgments are deleted from an acknowledge transmission queue.

The present invention further includes an automatic address allocation and configuration method in transmissions employing a hybrid access system. According to the present invention, remote users are identified initially with an abstract name, e.g., "Bob," and this abstract name is registered by the network management system. Configuration is established by the downstream routers polling the remote users and registering the location of the remote user responding to the poll made with the particular abstract name. Internet Protocol address and upstream channel allocation is accordingly accomplished subject to the configuration made including abstract name and identified location.

The present invention further includes a prioritized polling method in transmissions employing a hybrid access system. According to a method of the present invention, hybrid upstream routers poll client devices such as remote link adapters (i.e., "RLAs") according to predetermined priority levels. According to one embodiment of the present invention, priority levels are established for state categories of RLAs. According to one embodiment of the present invention,

priority level states include status states such as idle, non-responsive, requesting channel(s), active, or active-credit. According to one embodiment of the present invention, RLAs which request a channel are prioritized according to the amount of time its channel requests have gone unfulfilled. According to one embodiment of the present invention hybrid upstream routers poll downstream RLAs which are idle more frequently than non-responsive RLAs.

The present invention further includes an automatic gain adjustment technique in transmissions employing a hybrid access system, according to which a remote link adapter sends successive indications to a hybrid upstream router at selected different power levels. When a power level indication is received by a hybrid upstream router, the receiving hybrid upstream router confirms receipt of such indication to the sending remote link adapter which then registers an associated power level as qualified. According to one embodiment of the present invention, the selected different power levels are dynamically adjusted in magnitude of transmission level.

The present invention further includes a quality-based upstream channel allocation technique in transmissions employing a hybrid access system. According to the technique, the hybrid upstream router first determines the availability of upstream cable channels by a frequency agile RLA setting a wide range of narrowband upstream channels. The upstream router then makes a quality assessment of available channels in view of most recent demand, and it finally selects an upstream channel in view of the quality assessment made.

Quality assessment includes determination of busy status and signal characteristics including error rates, noise floor, and signal to noise ratio. Upstream channels are releasable according to inactivity or time-out criteria, according to which release or reassignment occurs responsive to inactivity for over a threshold period. Inactivity is assessed by the hybrid upstream router monitoring operability indications and data packets received from assigned RLAs.

The present invention further includes a credit allocation technique in transmissions employing a hybrid access system. According to a method of the present invention, an upstream channel is shared by a plurality of RLAs in accordance with a credit criterion, and credit control packets are dispatched to a RLA which permit the RLA to send data packets to arbitrary hosts. Upon sending a data packet, the RLA returns the credit control packet to a server containing software including Hybridware™ code which manages data flows. The Hybridware™ code or Hybridware™ server, according to one embodiment of the present invention, includes software distributed among data processors in the upstream and downstream routers and elsewhere in the HASPOP, including for example in the network management system.

DESCRIPTION OF THE DRAWINGS

Figure 1 is a detailed schematic drawing of a hybrid access system connected to a backbone network such as the Internet, and having points of presence connecting the backbone network to cable TV headends, TV transmitters, or Logical Nodes (e.g., cell sites), with remote users connecting to an

RLA which in turn connects to downstream TV channels and independent lower speed upstream channels;

Figure 2a is a schematic drawing of a hybrid access system point of presence (POP) according to the present invention including at least a single host computer or server and at least a single router including a hybrid downstream router, a hybrid upstream router, a dial-up router, an Internet router, or a backbone network router, and a POP LAN switch;

Figure 2b is a block diagram of a downstream router according to the present invention;

Figure 2c is a block diagram of an upstream router according to the present invention;

FIGS. 3a, 3b, and 3c comprise a pictorial diagram of a hybrid access system according to the present invention according to which a remote user can communicate with an information provider through the hybrid access system;

Figure 4 is a logical data flow diagram showing data flows between a server and a client computer of the hybrid access system according to the present invention;

Figure 5 is a flow chart of operation of a two-way cable network

embodiment of the hybrid access system according to the present invention;

Figure 6 is a flow chart of operation of a one-way cable network embodiment of the hybrid access system according to the present invention, including provision for upstream telephone system data flow;

Figure 7 is a Hybridware™ server state diagram of the upstream channel allocation method according to the present invention;

Figure 8 is a Hybridware™ client state diagram of the upstream channel allocation method according to the present invention;

Figure 9 is a logical data flow diagram showing data flows between router server and client computers of the hybrid access system for automatic handling of multiple clients according to automatic address allocation methods of the present invention;

Figure 10 is a flow chart of address allocation control protocol according to the present invention;

Figure 11 is a state diagram of the hybrid adaptive gain control protocol according to the present invention;

Figure 12a is a transmission diagram of information exchange between

two nodes in an asymmetric network according to the present invention, having a high downstream data rate of n bits per second and a lower upstream data rate of m bits per second;

Figure 12b is a diagram of conventional downstream messaging of first through fourth data packets, 100, 250, 325, and 450, between first and second nodes, in parallel with upstream transmission of receipt acknowledge indications;

Figure 12c is a diagram of a conventional transmission buffer queue in a RLA of a remote client station;

Figure 12d is a diagram indicating a redundant acknowledgment packet in a conventional transmission buffer queue in a RLA of a remote client station;

Figure 12e is a diagram of a conventional transmission buffer queue, indicating no need for an earlier acknowledgment (ack 100) packet in view of a new acknowledgment (ack 210) packet that supersedes the earlier acknowledgment packet;

Figure 12f is a diagram of first through fourth network nodes serially connected to each other in accordance with the present invention, wherein the link between the second and third nodes is asymmetric and that between the first and second and the third and fourth nodes are symmetric;

Figure 13 is a tabular description of transmission control protocol/ Internet protocol (TCP/IP) data transmission packet protocol header as used in connection with the present invention;

Figure 14a is a diagram of a sequential data transmission between first and second network nodes, according to the present invention;

Figure 14b is a diagram of the contents of a conventional transmission queue in the downstream node during a first time period;

Figure 14c shows the contents of a transmission queue in a downstream node during a later time period, eliminating retransmission of the 300 packet, according to the present invention, because another 300 packet was already in the transmission queue;

Figure 15 is a flow diagram of the acknowledge suppression method according to the present invention;

Figure 16 is a flow diagram of the packet suppression method according to the present invention;

Figure 17 is a flow diagram of information exchanges between Hybridware™ server and client, under conditions in which the client has no information to transmit;

Figure 18 is a flow diagram of information exchanges between Hybridware™ server and client, under conditions in which the client has information to transmit and the server gradually allocates bandwidth to the client;

Figure 19 is a flow diagram of information exchanges between Hybridware™ server and client, under conditions in which the server allocates the client a dedicated channel, the client transmits data and periodically reports to the server with done messages; and

Figure 20 is a flow diagram of information exchanges between Hybridware™ server and client, under conditions in which a dedicated channel is converted into a shared channel.

Description of the Preferred Embodiment

Figure 1 is a detailed schematic drawing of a hybrid access system 1 according to the present invention, showing a RLA and user workstation 29 connected through hybrid access system 1 to a variety of entities connected to a backbone network 20 such as Internet, including information providers 21, corporations 22, government agencies 23, universities 24, and others 25. A backbone network is one which is typically not directly connected to a user. Hybrid access system 1 according to an embodiment of the present invention includes hybrid access system (HAS) points of presence (POPs) 26 and other points of presence 27. HASPOPs 26 include individual HASPOPs 26(1)-26(3) which enable communication over a broadband network, either by upstream and

downstream cable communications or by downstream cable and upstream telephone communications or various other hybrid configurations (e.g., wireless or satellite). The present invention particularly includes (1) a hybrid access configuration which uses downstream cable TV channels and upstream public switch telephone network (PSTN), wireless RF communications or integrated services digital network (ISDN) telephone lines; (2) a hybrid access configuration which uses downstream wireless TV channels and upstream public switch telephone network (PSTN), wireless RF communications or integrated services digital network (ISDN) telephone lines; (3) a hybrid access configuration which uses both downstream and upstream cable TV channels; (4) a hybrid access configuration which uses both downstream and upstream wireless channels; and (5) a hybrid access configuration with downstream satellite channels and upstream PSTN, wireless RF communications or ISDN telephone channels.

Backbone network 20 such as the Internet which includes a plurality of Internet servers 20' connected to HASPOPs 26 each including a plurality of host computers and/or servers, collectively referred to as hybrid servers. Hybrid access system 1 further includes broadcast units such as, a cable television (TV) head end 28, independent upstream channels 28; and a RLA 29. U.S. Pat. No. 5,347,304 (1994) assigned to Hybrid Networks, Inc., and describing an example of an RLA is hereby expressly referenced and incorporated herein in its entirety. An RLA may receive analog broadcast signals including encoded digital information which the RLA decodes and provides to a data terminal or computer. According to an embodiment of the present invention, the downstream flow of information

proceeds from HASPOPs 26(1)-26(3) through cable TV head end or TV transmitters 28 or cell sites 30 and through RLA and user workstation 29. Upstream information flow proceeds in one case from RLA and user workstation 29 through independent upstream channels 28; to HASPOP 26(1), and then to backbone network 20; along T1 or T3 or other digital lines. In another case, upstream information proceeds from user workstation through RLA 29 through the cable TV network, and cable TV head end 28 to hybrid access system point of presence and then through T1, T3, or other digital lines to backbone network 20. The outputs of the cable TV headends or TV transmitters 28 include pluralities of high speed downstream broadband radio frequency, i.e., RF, channels connected to respective remote users 29. Hybrid access system 1 further includes a plurality of cell sites 30 connected through high speed links to a corresponding hybrid access system point of presence 5. The outputs of cell sites 30 include pluralities of high speed downstream broadband channels connected to selected remote users 29. A particular remote user 29 can be connected via an independent lower speed upstream channel to a hybrid access system point of presence 26 as discussed below or via a similar independent lower speed upstream channel to another point of presence system 27. By lower speed it is meant at a speed reduced from the speed of the high speed link used to transmit information downstream. A particular hybrid access system point of presence 5 can be connected via duplex high speed links to a plurality of cable TV headends or TV transmitters, to a plurality of cell sites 30, or a combination of cable TV headends or TV transmitters 28 and cell sites 30.

Figure 2a is a schematic drawing of a point of presence (POP) system 26(1) according to the present invention, including host computers or servers 39 and a POP local area network, i.e., LAN switch 33 to which host computers or servers 39 are connected. Further connected to LAN switch 33 are one or more downstream and one or more upstream hybrid access system point of presence routers, respectively 34 and 35, one or more dial-up routers 36, a network management system 37, and conventional routers 38. Connected to POP LAN switch 33 are one or more data storage elements or systems. Each downstream hybrid access system point of presence router 34 is connected with a high speed link to a TV transmitter or cable TV headend, for example. Further, each upstream hybrid access system point of presence router 35 is connected to a plurality of independent upstream channels, which operate at a lower speed than the downstream high speed links to TV transmitters or cable TV headends. Each dial-up router 36 is connected to a plurality of independent upstream channels operating at a lower speed than the indicated downstream high speed links. Each conventional router 38 is connected along a high speed line to wide area network (WAN) lines to selected information providers, Internet, or other nodes or businesses. POP LAN switch 33, according to one embodiment of the present invention is connected directly along a high speed line to wide area network (WAN) lines to selected information providers, Internet, or other nodes or businesses.

Figure 2b is a block diagram of hybrid downstream router 34 according to the present invention. In particular, downstream router 34 includes network

interface 34a, link interface 34b, physical interface 34c, controller 34d, physical interface 34e, link interface 34f, and network interface 34g. Downstream router 34 and physical interface 34e are connected to POP LAN switch 33 for sending and receiving information, and physical interface 34e, link interface 34f, and network interface 34g are serially connected to each other and to controller 34d for bidirectional communication of selected information. Additionally, controller 34d is connected directly to each of physical interface 34e and link interface 34f along indicated lines to accomplish control and messaging functions. Downstream router 34 and physical interface 34c are connected to cable TV headends, TV broadcast sites, cell cites or the like, to communicate information primarily or exclusively in a unidirectional or downstream direction, and physical interface 34c, link interface 34b, and network interface 34a are serially connected to each other and to controller 34d for selected communication of selected information. Additionally, controller 34d is connected directly to each of physical interface 34c and link interface 34b along indicated lines to accomplish control and messaging functions. Downstream router 34 may include one or more of physical interfaces 34c. According to an embodiment of the present invention, router 34 may be a bridge without network interfaces 34a and 34g or a connection without network interfaces 34a and 34g and without link interfaces 34b and 34f. According to yet another embodiment of the present invention, router 34 can be a gateway.

Figure 2c is a block diagram of upstream router 35 according to the present invention. In particular, upstream router 35 includes network interface 35a, link interface 35b, physical interface 35c, controller 35d, physical interface

35e, link interface 35f, and network interface 35g. Upstream router 35 and physical interface 35e are connected to POP LAN switch 33 for sending and receiving information, and physical interface 35e, link interface 35f, and network interface 35g are serially connected to each other and to controller 35d for bidirectional communication of selected information. Additionally, controller 35d is connected directly to each of physical interface 35e and link interface 35f along indicated lines to accomplish control and messaging functions. Upstream router 35 and physical interface 35c are connected to upstream channels, e.g., telephone links for example, to communicate information primarily or exclusively in a unidirectional or upstream direction, and physical interface 35c, link interface 35b, and network interface 35a are serially connected to each other and to controller 35d for selected communication of selected information. Additionally, controller 35d is connected directly to each of physical interface 35c and link interface 35b along indicated lines to accomplish control and messaging functions. Upstream router 35 may include one or more of physical interfaces 35c. According to an embodiment of the present invention, router 35 may be a bridge without network interfaces 35a and 35g or a connection without network interfaces 35a and 35g and without link interfaces 35b and 35f. According to yet another embodiment of the present invention, router 35 can be a gateway.

Figures 3a-3b are drawings of a hybrid access system 1 according to the present invention according to which remote user having a workstation 2 or connected to LAN 61, as shown respectively in Figures 3b and 3c can communicate with a selected information provider 21 including LAN 50, bridge

or router 51 connected to LAN 50, and dial-up router 52 connected to LAN 50 through a hybrid access system point of presence 26. Further, HAS POP is connected along a high speed link to bridge or router 51. Additionally, HAS POP 26 is linked to other information providers to receive selected information items. Additionally, dial-up router 52 is connected to a plurality of upstream channels. Figures 3b and 3c additionally show respective first and second users, in one case including workstation 2 in turn including a RLA 60 and in the other instance including RLA 60 and a local area network (LAN) 61 connected to RLA 60. First user 29(1) is connected to an upstream channel from user workstation 2, and second user 29(2) is connected to an upstream channel directly from RLA 60. In the case of each user, RLA 60 receives input information, particularly radio frequency (RF) information along one of respective input channels connected thereto.

Figure 4 is a logical data flow diagram showing data flows between a server and a client computer of the hybrid access system 1 according to the present invention. Hybrid access system 1 includes a server application 70, a hybrid system manager 71, and a Hybridware™ server 72 connected to LAN 38. Hybrid access system 1 further includes a Hybridware™ client 73 and a client application 74 operating with Hybridware™ client 73. Hybridware™ client 73 communicates with Hybridware™ server 72, as transmitter along upstream channel 75 or as receiver along downstream channel 76. Downstream data traffic is expected to be higher capacity than upstream data traffic: Hence, the bolder depiction of downstream channel 76 than upstream channel 75.

Figure 5 is a flow chart of operation of a two-way cable network embodiment of hybrid access system 1 according to a hybrid protocol embodiment of the present invention. In particular, according to one embodiment of the hybrid protocol of the present invention, client application 74 sends 100 data to server application 70 in an upstream direction, thereby issuing a connection request. Hybridware™ client 73 buffers the data received and checks if it controls an upstream data channel. If it does, then the data is transmitted forthwith. If it doesn't, Hybridware™ client 73 queues up the data message and creates 101 a channel request for a particular subchannel within upstream channel 75. Hybridware™ client 73 then waits 102 for a poll from Hybridware™ server 72, i.e., Hybridware™ router. According to an embodiment of the present invention, prioritized polling is conducted whereby not all clients are polled at the same frequency. Clients in an idle state are polled relatively frequently. Clients in blocked and NON-RESP states are polled but not at the same relatively high frequency. Clients in an ACTIVE state are not polled at all. This is based on the assumption that an active client has what it wants and that it is most important to respond quickly to new connections coming from clients in an IDLE state. Those clients coming from a NON_RESP cycle receive second order attention and can wait a little longer, since they may have already been in a state where communication are impossible and may have been in that state for a considerable period of time. According to one embodiment of the present invention, a poll cycle is the smallest period such that all but active clients are polled at least once. Idle clients may be polled multiple times during one poll cycle. Blocked and non_resp clients are distributed evenly across the poll cycle to assure that the

latency for acquiring a channel for idle units is uniform. All clients are grouped according to their state and polled within each group according to the round robin approach according which each of a series is polled in sequence and then the same sequence is repeatedly polled individual by individual. Upon receipt of a poll, Hybridware™ client 73 sends 103 a channel request via lower speed upstream channel 75. Hybridware™ router 72, i.e., server, receives 104 the channel request from Hybridware™ client 73 and initially sends 105 a login message to Hybridware™ system manager 71. Hybridware™ system manager 71 verifies 106 that Hybridware™ client 73 is an authorized user of data processing services on the particular node or system within which hybrid access system 1 operates. Then, Hybridware™ router 72 receives 107 a login response message from Hybridware™ system manager 71 through LAN 38, which indicates whether the client is allowed to operate on the particular network and which contains other operating characteristics of Hybridware™ client 73. Hybridware™ router 72 then allocates 108 (see state diagrams of Figures 7 and 8) an upstream channel 75 for Hybridware™ client 73, depending on channel availability and suitability. Suitability depends on factors including but not limited to channel quality, type of service required, operating characteristics of Hybridware™ client 73, configuration restrictions, and the like. Hybridware™ router 72 sends 109 an upstream channel allocation message to Hybridware™ client 73 via high speed downstream channel 76, which may according to one embodiment of the present invention specify the frequency on which Hybridware™ client 73 is permitted to transmit. Thereafter, Hybridware™ client 73 receives 110 an upstream channel allocation. Next, Hybridware™ client 73 tunes 111 to the specifically allocated

upstream data channel frequency on which it is permitted to transmit data. Finally, Hybridware™ client 73 sends 112 the selected application data from client application 74. Accordingly, client application 74 and server application 70 are able to send and receive 113 data via upstream bandwidth management of an asymmetric hybrid access system, according to the present invention.

Figure 6 is a flow chart of operation of a one-way cable network embodiment of the hybrid access system 1 according to the present invention, including provision for upstream telephone system data flow. According to this embodiment of the present invention, when client application 74 needs to communicate with server application 70 in an upstream direction, Hybridware™ client 73 dials 202 Hybridware™ router 72. Then, Hybridware™ client 73 sends 203 a channel request via lower speed PSTN upstream channel (not shown). Hybridware™ router 72 receives 204 the channel request and sends 205 a login message to Hybridware™ system manager 71. Hybridware™ system manager 71 verifies 206 Hybridware™ client 73 as an authorized user. Then, Hybridware™ router 72 receives 207 a login response from Hybridware™ system manager 71. Hybridware™ router 72 sends 208 an authorization message to Hybridware™ client 73 via high speed downstream channel 76. Hybridware™ client 73 receives 209 the authorization message for use of a selected upstream PSTN channel. Finally, Hybridware™ client 73 sends 212 the selected application data. Accordingly, client application 74 and server application 70 are able to send and receive 213 selected data via the asymmetric hybrid access system 1.

Figure 7 is a Hybridware™ server state diagram for upstream channel allocation of the hybrid access system according to one embodiment of the present invention. According to the state diagram of Figure 7, the Hyrbridware ™ server can be in one of four states: IDLE 301, NON_RESP 304, BLOCKED 302, or ACTIVE 303. In the IDLE state, the Hybridware™ server expects an IDLE poll response. If there is no request to the client from the application or a channel request message, or if there is application data that needs to be sent in the upstream direction. Upon receiving a channel request message, the server transitions the client to a BLOCKED state. In a BLOCKED state, the server sends one of two messages to the client, a channel allocation message or a no channel available message. Upon sending a channel allocation message, the server transitions the client to an ACTIVE state. Upon sending a no channel available message, the client remains in a BLOCKED state. The client will remain in the BLOCKED state until either a channel becomes available in which case the server will transition the client to the ACTIVE state or the server receives a channel release message in which case the server will transition the client to the IDLE state. In the ACTIVE state, the server does not poll the client. The server transitions the client from ACTIVE to IDLE upon receiving a channel deallocation message or upon detecting a system defined inactivity time-out. In the ACTIVE state, the server waits for a periodic heartbeat message from the client. The Hybridware™ server software awaits periodic heartbeat messages from the client at selected time intervals. The server software monitors other channel quality parameters including errors and signal to noise ratios. If the server stops hearing a certain number of operability indications or signals within a system

defined interval as to a particular client, or if particular parameters (e.g., signal to noise ratio) exceed a predetermined threshold , then the server sends a directed poll to the particular client. Essentially, the client is instructed to respond on another control frequency. If the client responds on the designated control frequency, the server reassigns the upstream channel to the client, so that it can continue to operate. If not, the client is deemed NON_RESP. Channel quality monitoring and channel reassignments are done transparently to the user and the applications. If a certain, system defined, consecutive count of heartbeat messages is missed, the server issues a special poll message or directed poll. If the client does not respond, the server transitions to the NON_RESP state. If the client responds to the poll, the server either remains in the ACTIVE state or transitions to the IDLE state. The former happens, if the client responds with a channel request message, and the latter happens, if the client responds with an IDLE poll response. In the former case, the server may decide to assign a different upstream channel to the client. In the BLOCKED or IDLE state, the server will transition the client to NON_RESP, i.e., "non-responsive," state after the client fails to respond to a system defined number of polls. The NON_RESP state is almost identical in terms of state transition to idle state, a difference being that an IDLE poll response transitions the client into an IDLE state.

Figure 8 is a Hybridware™ client state diagram for upstream channel allocation of the hybrid access system 1 according to an embodiment of the present invention, involving two way cable communication. According to this embodiment, the hybrid upstream client protocol has three states, IDLE 401,

CON_REQ, i.e., "connect request" 402, and ACTIVE 404. In the IDLE state, the client, when polled, will transmit an IDLE poll response, if there is no request from the application. However, it will respond with a channel request message, if there is data that needs to be sent upstream. Upon transmitting a channel request message, the client transitions to a CON_REQ state. In the CON_REQ state, the client expects one of two messages from the hybrid router, a channel allocation or a no-channel allocation signal. Upon receiving a channel allocation message, the client informs the application and tunes to the channel it was allocated and transitions to the ACTIVE state. Upon receiving a no-channel available message, the client informs the application and transitions to the IDLE state. In the ACTIVE state, the client forwards data messages from the application to the upstream transmitter. In the ACTIVE state, the client further monitors the application activity and if it detects that no data has moved from the application to the upstream transmitter for a system defined period of time, it will send a channel deallocation request and transition to an idle state. In an ACTIVE state, the application may explicitly request that the channel be released, in which case the client will send a channel deallocation request to the hybrid router and will transition to the IDLE state. In the ACTIVE state, the client periodically sends an operability indication message to the server. If the client receives a poll message during the ACTIVE state, it will send a channel request message and will transition to a CON_REQ state. The hybrid router may also send an unsolicited channel release message, in which case the client will notify the application and transition from ACTIVE state to IDLE state.

Figure 9 is a logical data flow diagram showing data flows between server and client computers of the hybrid access system 1 according to the present invention, for multiple clients under an address allocation protocol simplifying distribution of IP addresses to remote systems. The protocol according to the present invention determines where a given Hybridware™ client is located and how to download its IP address, given that the client has no address yet. Hybrid access system 1 includes a server application 70, a hybrid system manager 71, and Hybridware™ servers 72a & 72b connected to LAN 38. Hybrid access system 1 further includes Hybridware™ clients 73a and 73b and client applications 74a and 74b operating with respective ones of Hybridware™ clients 73a and 73b. Hybridware™ client 73a communicates with Hybridware™ server 72a, as transmitter along upstream channel 75a or as receiver along downstream channel 76a. Hybridware™ client 73b communicates with Hybridware™ server 72b, as transmitter along upstream channel 75b or as receiver along downstream channel 76b. Downstream data traffic is expected to be higher capacity than upstream data traffic: Hence, the bolder depiction of downstream channels 76a and 76b than upstream channels 75a and 75b.

Figure 10 is a flow chart of address allocation control according to an embodiment of the present invention to logon and configure Hybridware™ clients with a selected unique node name which is entered in the configuration database in the hybrid system manager 71 which is the software portion of network management system 37. In particular, hybrid system manager 71 sends a new client message to all hybrid routers 72a and 72b after learning of particular new

clients by message, mail, or telephone call (step 500 in Figure 10). At this point the hybrid system manager is aware of a Hybridware™ client identification name and equipment serial number, but has not associated the client identification name with a separate unique client address (e.g., Internet Protocol, or IP address) provided by separate automatic registration. Each hybrid router 72a and 72b periodically broadcasts a configuration poll message (step 501). Hybridware™ clients recognize their preselected unique names during a configuration poll (step 502). Hybridware™ clients 72a and 72b respond to the configuration poll. Hybrid routers 72a and 72b receive respective configuration poll responses. Then, hybrid routers 72a and 72b send respective client found messages to system manager 71. System manager 71 then sends a cease configuration poll message to all hybrid routers. Further, system manager 71 allocates an Internet protocol (IP) address and other configuration data for each new client according to the preselected unique names. System manager 71 sends the IP address and other configuration data to the applicable hybrid router 72a, 72b. Then, the applicable hybrid router 72a, 72b sends, using broadcast or unicast and the unique name, the corresponding IP address and other configuration data to the applicable Hybridware™ client. As a result, the Hybridware™ client receives the IP address and other configuration data determined and reconfigures appropriately. In summary, according to the present invention, an automatic address allocation and configuration method in transmissions employs a hybrid access system. Remote users are identified initially with a unique abstract name, e.g., "Bob," and this abstract name is registered by the network management system. Configuration is established by the upstream routers polling the remote users and registering the

location of the remote user responding to the poll made with the particular abstract name. Upstream channel allocation is accordingly made subject to the configuration made including abstract name and identified location. Automatic address allocation and configuration is accordingly accomplished on line at an initial log-on session with a new user. The method of the present invention is accordingly swift and simple, eliminating registration delays experienced by many known log-in systems.

Figure 11 is a state diagram of the hybrid adaptive gain control protocol according to the present invention, which overcomes noise and attenuation while transmitting on cable in an upstream direction. The hybrid adaptive gain control protocol has a SEARCHING state 600 and a STABLE state 601. In the STABLE state 601, the protocol evaluates poll messages from the hybrid router. If a poll message indicates loss of a poll response, the protocol transitions to the SEARCHING state 600. Poll responses are transmitted at a fixed power level. In the SEARCHING state 600, the client system responds to polls with a poll response at larger and larger power levels. After receiving a system specified, number of consecutive polls with an indication of a successful poll response, the system transitions to the STABLE state.

Figure 12a is a transmission diagram of information exchange between nodes A and B. Nodes A and B comprise an asymmetric network according to the present invention, having a high downstream data rate of n bits per second and a lower upstream data rate of m bits per second. The downstream data rate n is

greater than the upstream data rate m. Node B includes receive and transmission queues to hold information received and to be sent, including acknowledge indications or messages. The acknowledge suppression method according to the present invention relates to the node or system transmitting data acknowledgments, which acknowledges receipt of either data packets or data bytes contained in incoming packets. The numbers on data packets indicate the position of the last data byte of the packet in the data stream, and the acknowledgment numbers indicate that all the bytes of the data stream up to and including the byte indicated have been received. According to the method of the present invention, the acknowledgment of byte k (or packet number k) indicates that all bytes or packets prior to k have been received. According to a method of the present invention, the transmit queue queues up additional acknowledgment packets as new packets are received. Figure 12b is a diagram of messaging of first through fourth data packets, 100, 250, 325, and 450, between upstream and downstream nodes, in parallel with upstream transmission of receipt acknowledge indications with respect to only two data packets, namely 250 and 450. Figure 12c is a diagram indicating acknowledgment of first and second packet receptions during a first time period. In particular, packet 1 (i.e., "pkt 1") is currently being sent, and an acknowledge (i.e., "ack 250") message is currently being appended at the end of the transmit queue. Figure 12d is a diagram indicating acknowledgment of another packet during another period. Figure 12e is a diagram indicating no need for an acknowledge 100 signal in view of a subsequent acknowledgment having been successful. In particular, according to the acknowledge suppression method of the present invention, not all acknowledgment packets will be sent to

node A, because the "ack 210" message carries information which supersedes the "ack 100" message. Accordingly, the amount of traffic on the communication link from B to A is reduced, according to the present invention. In general, this introduces an acknowledge latency, but where all messages queued up for transmission are acknowledgments, acknowledgment latency is reduced. For example, when an "ack 15" signal is transmitted and an "ack 100" message awaits transmission, and an "ack 210" message is appended to the queue, the acknowledge suppression method according to the present invention will delete the "ack 100" message as superfluous. Any new acknowledgments appended while "ack 15" is being transmitted will result in deletions of unnecessary acknowledgments keeping queue length to two. Upon transmit completion of "ack 15," the next acknowledgment, e.g., "ack 210" will be transmitted. Accordingly, the method of the present invention eliminates unnecessary transmission of "ack 100" signals and provides for reduced acknowledgment latency for "ack 210." The ack suppression method according to the present invention, accordingly reduces the probability of queue overflow and potential out of memory conditions in system B. It reduces the load on the communication link from B to A, and in some circumstances reduces acknowledgment latency for data transfers from B to A.

Figure 12f is a diagram of first through fourth network nodes serially connected to each other in accordance with the present invention, wherein the link between the first and second nodes is symmetric, the link between the second and third nodes is asymmetric and that between the third and fourth nodes is symmetric. The acknowledge suppression method of the present invention applies to both the communications system of Figure 12a, in which nodes A and B are end nodes, as

well as to the communications system of Figure 12f, in which nodes B and C arc intermediate systems such as a router, and data packets originating at node D are transmitted through router nodes C and B to a central system connected to node A.

Figure 13 is a tabular description of a transmission control protocol/ Internet protocol (TCP/IP) data transmission packet protocol header as used in connection with the present invention. The first five 32 bit words and the following IP options are referred to as the IP header. The five words following the IP options together with the words containing TCP options are referred to as the TCP header. The non-ack TCP header is the TCP header less the acknowledgment number field.

Figure 14a shows sequential data transmission between first and second nodes, according to the present invention. As shown in Figure 14a, data packets or bytes 100-700 are transmitted from node A to node B. Concomitantly, acknowledge messages, "ack 100," "ack 200," and "ack 300," were dispatched from node B to node A.

Figure 14b shows a data packet sequence of packets 100-400 held in the transmit queue during a first time period, followed by a single acknowledgment, "ack 100."

Figure 14c is a diagram of a data packet sequence transmitted during a

later time period, eliminating retransmission of the 300 packet, because another 300 packet was already in the transmission buffer.

Figure 15 is a flow diagram of an acknowledge suppression (AS) method, i.e., an AS method, according to the present invention in which receipt of information transmitted from system A to system B over a first independent simplex communication link is acknowledged by system B. The method of the present invention starts 1500 at a particular time, and a first packet Mi of information is received 1501. If the transmit queue is not empty 1502, the header of the last packet Mi+1 on the transmit queue is obtained 1503. If the transmit queue is empty 1502, then Mi is enqueued 1509 and the AS method according to the present invention is completed. If the header of the next packet Mi+1 on the transmit queue equals 1504 the header of packet Mi, and the NON-ACK TCP header of Mi equals 1505 the NON-ACK TCP header of Mi, then Mi+1 is discarded 1506. If the header of the last packet Mi+1 on the transmit queue does not equal 1504 the header of packet Mi, or the NON-ACK TCP header of Mi does not equal 1505 the NON-ACK TCP header of Mi, then Mi is enqueued 1509 and the AS method according to the present invention is completed. If Mi+1 is not the last message on the queue 1507, then the header on the next packet Mi+1 on the transmit queue is obtained 1508, and a comparison is done to determine whether the header of the last packet Mi+1 on the transmit queue equals 1504 the header of packet Mi. If Mi+1 is the last message on the queue 1507, then Mi is enqueued 1509 and the AS method according to the present invention is completed.

Figure 16 is a flow diagram of the packet suppression (PS) method according to the present invention. The method of the present invention starts 1600 at a particular time, and a first packet Mi of information is received 1601. If the transmit queue is not empty 1602, the header of the last packet Mi+1 on the transmit queue is obtained 1603. If the transmit queue is empty 1602, then Mi is enqueued 1609 and the PS method according to the present invention is completed. If the header of the last packet Mi+1 on the transmit queue equals 1604 the header of packet Mi, then Mi+1 is discarded 1606. If the header of the last packet Mi+1 on the transmit queue does not equal 1604 the header of packet Mi, then Mi is enqueued 1609 and the PS method according to the present invention is completed. If Mi+1 is not the last message on the queue 1607, then the header on the next packet Mi+1 on the transmit queue is obtained 1608, and a comparison is done to determine whether the header of the last packet Mi+1 on the transmit queue equals 1604 the header of packet Mi. If Mi+1 is the last message on the queue 1607, then Mi is enqueued 1609 and the PS method according to the present invention is completed.

Figure 17 is a flow diagram of information exchanges between Hybridware™ server and client, according to conditions in which the client has no data to transmit. A credit (1, F) corresponding to a single predetermined amount of data, e.g., ten bytes, or ten packets, at a selected frequency F is transmitted from node A to node B, and a done signal DONE(0,0) is transmitted from node B to node A, indicating that no data packet was transmitted, leaving the existing credit level of the particular channel unchanged. The credit protocol according to

the present invention permits single upstream cable channels to be shared by multiple remote link adapters. Alternatively, a single upstream channel is controlled and used by a single remote link adapter until the channel is relinquished. The present invention includes an allocation method in transmissions employing a hybrid access system. According to a method of the present invention, an upstream channel is shared by a plurality of remote link adapters in accordance with a credit criterion, and credit control packets are dispatched to a remote link adapter which permit the remote link adapter to send data packets to arbitrary hosts. Upon sending a data packet, the remote link adapter returns the credit control packet to a Hybridware™ server. A credit permits a remote link adapter to send a certain number of packets up to a maximum number controlled by a configuration parameter MAX._CREDIT_PACKETS, thereby eliminating polling for that period. If a remote link adapter does not have a data packet to send, it returns the credit to the hybrid access system without sending any data packets. The remote link adapter then sets a field in the credit control packet to the number of packets which was sent. If the protocol process at the server does not receive credit status information from the credit control packet within a certain credit time-out, CREDIT_TIMEOUT, in milliseconds, for a certain number of times, FAIL_CNT, consecutively, the remote link adapter is assumed to be in error and is put in a not-responding state (NON_RESP). The overall upstream channel performance of a remote link adapter using a credit channel is lower than a remote link adapter on a sole use upstream channel. If any sole use upstream channel becomes available, this channel is given to the credit remote link adapter that has been waiting the

longest for a sole use upstream channel that currently has packets to send.

Figure 18 is a flow diagram of information exchanges between Hybridware™ server and client, according to conditions in which the client has information to transmit and the server gradually allocates bandwidth to the client. In particular, a node first provides a single credit at a selected frequency F. Then a packet is sent, consuming the credit, followed by a completion message indicating use of one credit and potential for an additional transmission corresponding to three credits. Next, a credit is provided corresponding to two packets at the selected frequency F, which is followed by two packet transmissions and a completion message indicating consumption of two credits and potential for transmission of one more. In response, another double credit is sent, followed by a single packet and an acknowledgment of transmission of one and potential for no more transmissions.

Figure 19 is a flow diagram of information exchanges between Hybridware™ server and client, according to conditions in which the server allocates the client a dedicated channel, the client transmits data and periodically reports to the server with done messages. In particular, a credit indication dedicating a channel at frequency F is provided, followed by 235 packet transmissions. According to prearrangement, a operability indication in the form of a DONE message is provided at an established time indicating potential for five more packet transmissions. The done message indicates completion of 235 packet transmissions, as an accounting function. Because the channel is dedicated,

further packet transmissions are made without specific further credit allocations.

Figure 20 is a flow diagram of information exchanges between Hybridware™ server and client, according to conditions in which a dedicated channel is converted into a shared channel. In particular, a credit indication code D indicating a dedicated channel at frequency F is provided, followed by transmission of 235 packets and a credit message stopping channel dedication and switching to a credit mode. Responsive to the credit message a DONE signal accounts for the 235 packets transmitted during the dedicated mode and indicates potential for five more transmissions. This is followed by a credit allocation of one at a selected frequency. Thus, one packet is transmitted, followed by a completion indication specifying potential for four more packets to be transmitted.

What is claimed is:

1. A hybrid access system for connecting at least a single client data processor with a network. comprising:

a local area network (LAN) system:

a hybrid system manager connected to said LAN system:

a downstream router connected to said LAN system for transmitting information:

an upstream router connected to said LAN system for receiving information. said upstream ~~bridge~~ router including a Hybridware™ server.

a broadcast unit connected to said downstream router:

a downstream channel connected to said broadcast unit for high speed transmission of information on said high speed downstream channel:

an independent upstream channel connected to said upstream router. which operates at a lower speed than said downstream channel:

at least a single remote link adapter connected to said upstream and downstream channels: and

a corresponding at least a single client data processor connected to said remote link adapter.

2. The hybrid access system according to claim 1. wherein said independent upstream channel includes a telephone network.

3. The hybrid access system according to claim 1, wherein said independent upstream channel includes a cable TV network.

4. The hybrid access system according to claim 1, wherein said independent upstream channel includes a wireless transmission path.

5. The hybrid access system according to claim 1, wherein said LAN system includes a LAN switch and a router.

6. The hybrid access system according to claim 1, wherein said broadcast unit includes at least one of a group consisting of a cable TV headend, a wireless TV transmitter, a satellite transmitter or a cell site.

7. A method of accessing a wide area network from any of a plurality of client processors each connected to an asymmetric hybrid network including high-speed downstream and lower-speed upstream channels controlled by a hybrid system manager and a router server, including the steps of:

providing a polling signal from a hybrid system manager to client processors,

issuing an upstream channel connection request by lower speed channel, if no upstream data channel is currently assigned to a client data processor.

conducting login communications between the router server and the system manager,

verifying authorized user status at the system manager level,

allocating an upstream channel by high speed downstream channel message, and

sending upstream data over the allocated lower speed upstream channel of the asymmetric hybrid access network.

8. The method according to claim 7, wherein providing a polling signal includes polling clients in an idle state at a selected frequency level of polling.

9. The method according to claim 7, wherein providing a polling signal includes polling clients in a blocked state at a selected frequency level of polling.

10. The method according to claim 7, wherein providing a polling signal includes polling clients in a non-responsive state at a selected frequency level of polling.

11. The method according to claim 7, wherein providing a polling signal includes polling clients in idle and blocked states at selected first and

second frequency levels of polling, and polling of clients in an idle state occurs more frequently than polling of clients in a blocked state.

12. The method according to claim 7, wherein providing a polling signal includes polling clients in idle and non-responsive states at selected first and second frequency levels of polling, and polling of clients in an idle state occurs more frequently than polling of clients in a non-responsive state.

13. The method according to claim 7, wherein idle clients are polled multiple times during a poll cycle and polling of blocked and non_resp clients is distributed evenly over a poll cycle to assure that the latency for acquiring a channel for idle units is uniform.

14. The method according to claim 7, wherein polling includes grouping clients by state and polling within each group round robin.

15. A method of high speed remote access of a wide area network from any of a plurality of client processors each connected to an asymmetric hybrid network including high-speed downstream and lower-speed upstream channels controlled by a hybrid system manager and a router server, including the steps of:

issuing an upstream channel authorization request by lower speed channel, for upstream data channel currently used by a particular client data processor.

conducting login communications between the router server and the system manager.

verifying authorized user status at the system manager level.

authorizing specific upstream channel use by high speed downstream channel message, and

sending upstream data over the allocated lower speed upstream channel of the asymmetric hybrid access network.

16. A method of high speed remote access of a wide area network from any of a plurality of client processors each connected to an asymmetric hybrid network including high-speed downstream and lower-speed upstream channels controlled by a hybrid system manager and a router server, including the steps of:

sending a new client message to a plurality of hybrid routers, which provides client names.

broadcasting a poll message to a plurality of clients using client names.

recognizing a client name.

providing a poll response.

receiving a poll response.

reporting a client found to a system manager.

ceasing polling.

providing an address to the client which responded to poll.

receiving the address sent, and

configuring the client with the address provided.

17. A method of transmitting data from an upstream transmit queue in an upstream transmitter node to a selected receiver node, comprising the steps of:

transmitting selected amounts of data from a transmit queue in a first node to a second node,

generating acknowledgments of data received by said second node,

eliminating from the transmit queue of the second node data acknowledgments which are redundant of other acknowledgments in said second transmit queue, and

filling open transmit queue spaces with additional data.

18. A method of determining polling frequency from an upstream communications mode of a hybrid access system with respect to a plurality of downstream nodes having polling status levels corresponding to activity states in which a remote link adapter may be set, comprising the steps of:

determining the priority status of predetermined remote link adapters in a hybrid access system; and

polling the remote link adapter having the highest priority status level.

19. A method of setting remote link adapter power level in a hybrid access system, comprising the steps of:

transmitting successive indications to a hybrid upstream router at selected different power levels.

confirming receipt of a first power level indication. and

setting the level of future transmissions to a power associated with confirmation of receipt.

20. A method of packet suppression in communication between first and second nodes having respective first and second transmit and receive queues. in which information packets having headers are transmitted from said first node to said second node. comprising the steps of:

loading the transmit queue of said first node with a first information packet;

loading a second information packet into the transmit queue of said first node;

checking the headers of said first and second information packets. and

suppressing one of said first and second information packets. if the headers are the same.

21. A method of credit administration between first and second computer nodes. for information amounts having predetermined information credit values. comprising the steps of:

sending a credit to a first computer node. which sets a response frequency;

receiving an information amount corresponding in value up to the amount of the credit received at said first computer node at said response frequency; and

sending a done signal to said second computer node indicative of the credit received less the amount of information received.

22. A method of operating a client node, comprising the steps of:

sending periodic operability indication messages during an active state.

receiving a poll message, and requesting channel connection.

23. A method of operating a server node, comprising the steps of:

receiving periodic operability indication messages during an active state.

sending a polling message, when a threshold interval has expired.

awaiting a poll response, and

entering a non-responsive state if response to polling is received.

24. A method of responding to detected quality levels in a communication channel. comprising the steps of:

detecting a quality characteristic with respect to a selected communication channel from a selected group of quality characteristics each which is defined by quantitative levels.

determining whether the quantitative level of the detected quality characteristic deviates with respect to a predefined norm. and

switching to another communication channel. if sufficient deviation is determined.

25. The method according to claim 2~~3~~4, ~~wherein~~ said group of quality characteristics includes time from last ~~operability~~ indication. signal to noise ratio. and error frequency.

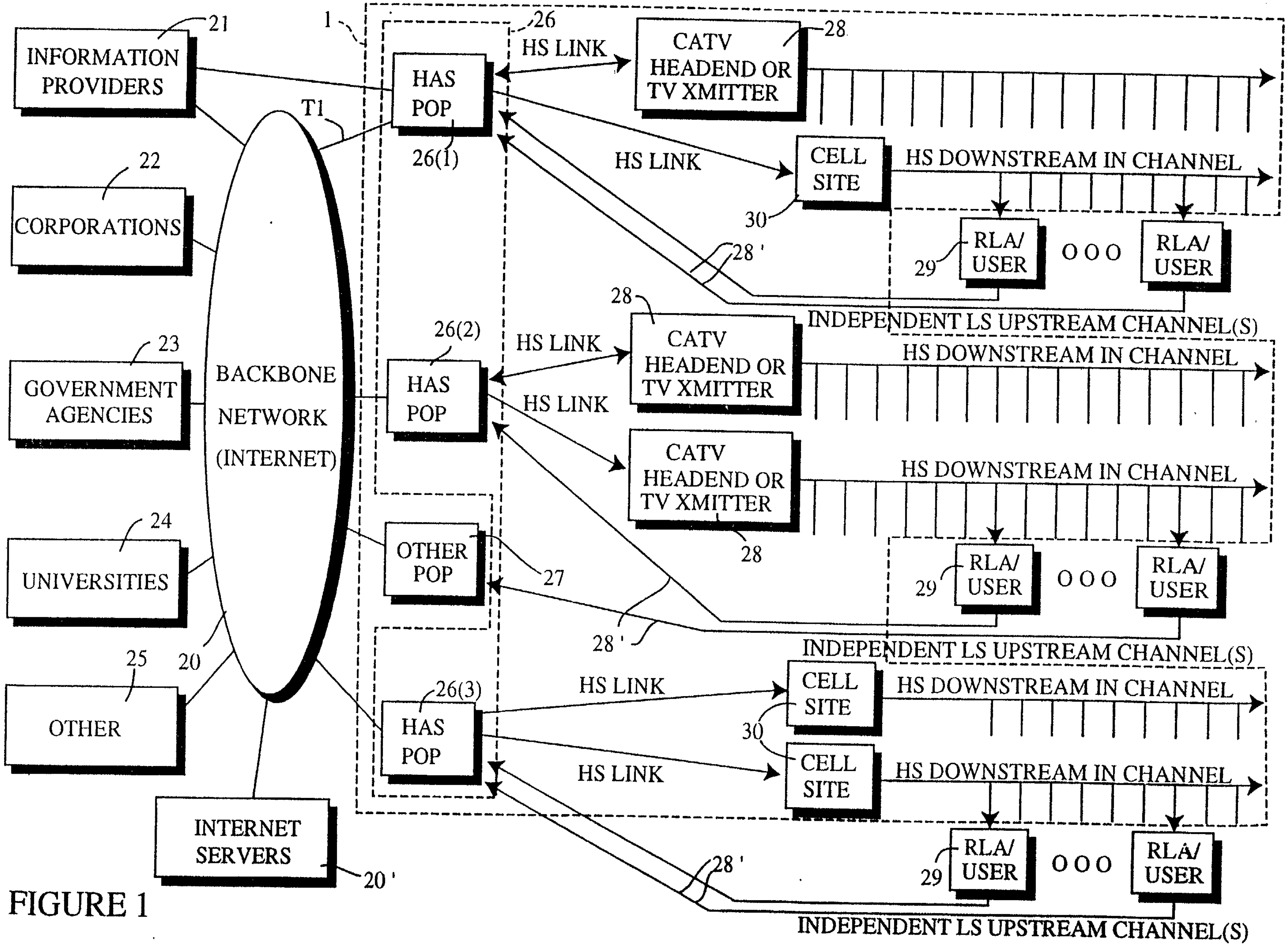

INFORMATION PROVIDERS
21
CORPORATIONS
22
GOVERNMENT AGENCIES
23
UNIVERSITIES
24
OTHER
25
INTERNET SERVERS
20'
BACKBONE NETWORK (INTERNET)
20
T1
1
26
HAS POP
26(1)
HAS POP
26(2)
OTHER POP
27
HAS POP
26(3)
HS LINK
CATV HEADEND OR TV XMITTER
28
CELL SITE
30
HS DOWNSTREAM IN CHANNEL
RLA/ USER
29
O O O
28'
INDEPENDENT LS UPSTREAM CHANNEL(S)

FIGURE 1

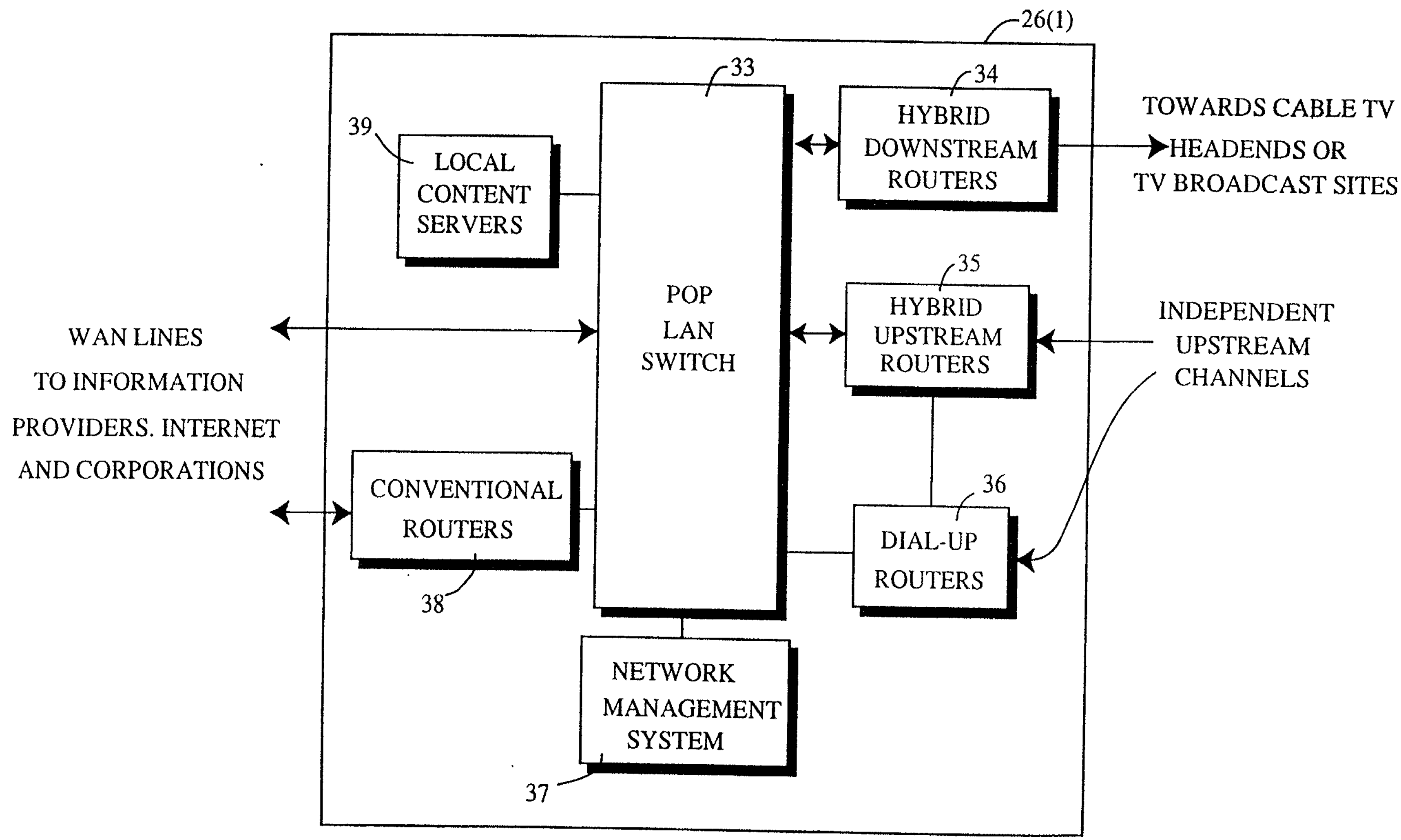

26(1)
33
34
39
LOCAL CONTENT SERVERS
POP LAN SWITCH
HYBRID DOWNSTREAM ROUTERS
TOWARDS CABLE TV HEADENDS OR TV BROADCAST SITES
35
HYBRID UPSTREAM ROUTERS
INDEPENDENT UPSTREAM CHANNELS
WAN LINES TO INFORMATION PROVIDERS. INTERNET AND CORPORATIONS
CONVENTIONAL ROUTERS
38
36
DIAL-UP ROUTERS
NETWORK MANAGEMENT SYSTEM
37

FIGURE 2a

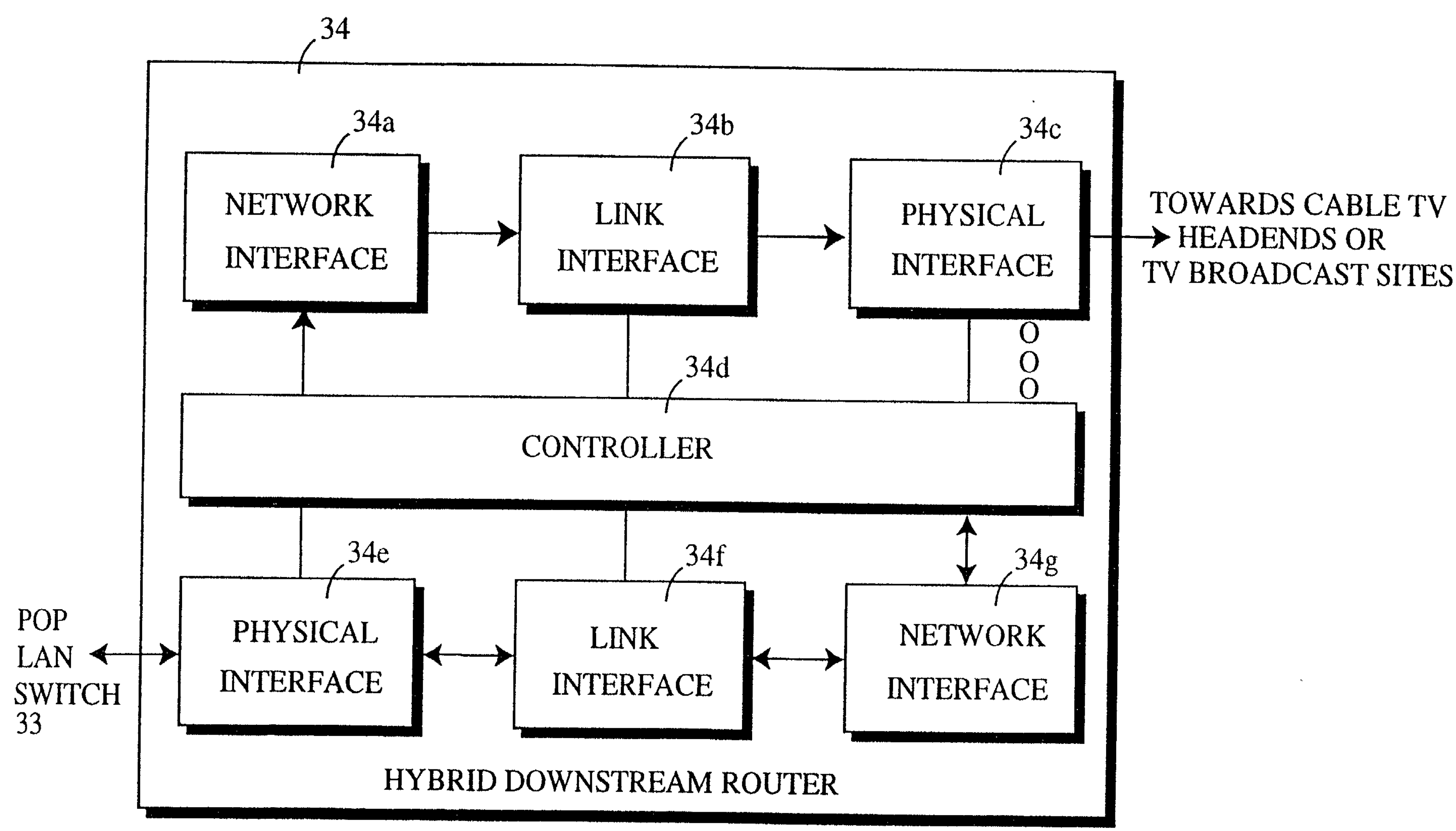

34
34a
NETWORK INTERFACE
34b
LINK INTERFACE
34c
PHYSICAL INTERFACE
TOWARDS CABLE TV HEADENDS OR TV BROADCAST SITES
O
O
O
34d
CONTROLLER
34e
PHYSICAL INTERFACE
34f
LINK INTERFACE
34g
NETWORK INTERFACE
POP LAN SWITCH 33
HYBRID DOWNSTREAM ROUTER

FIGURE 2b

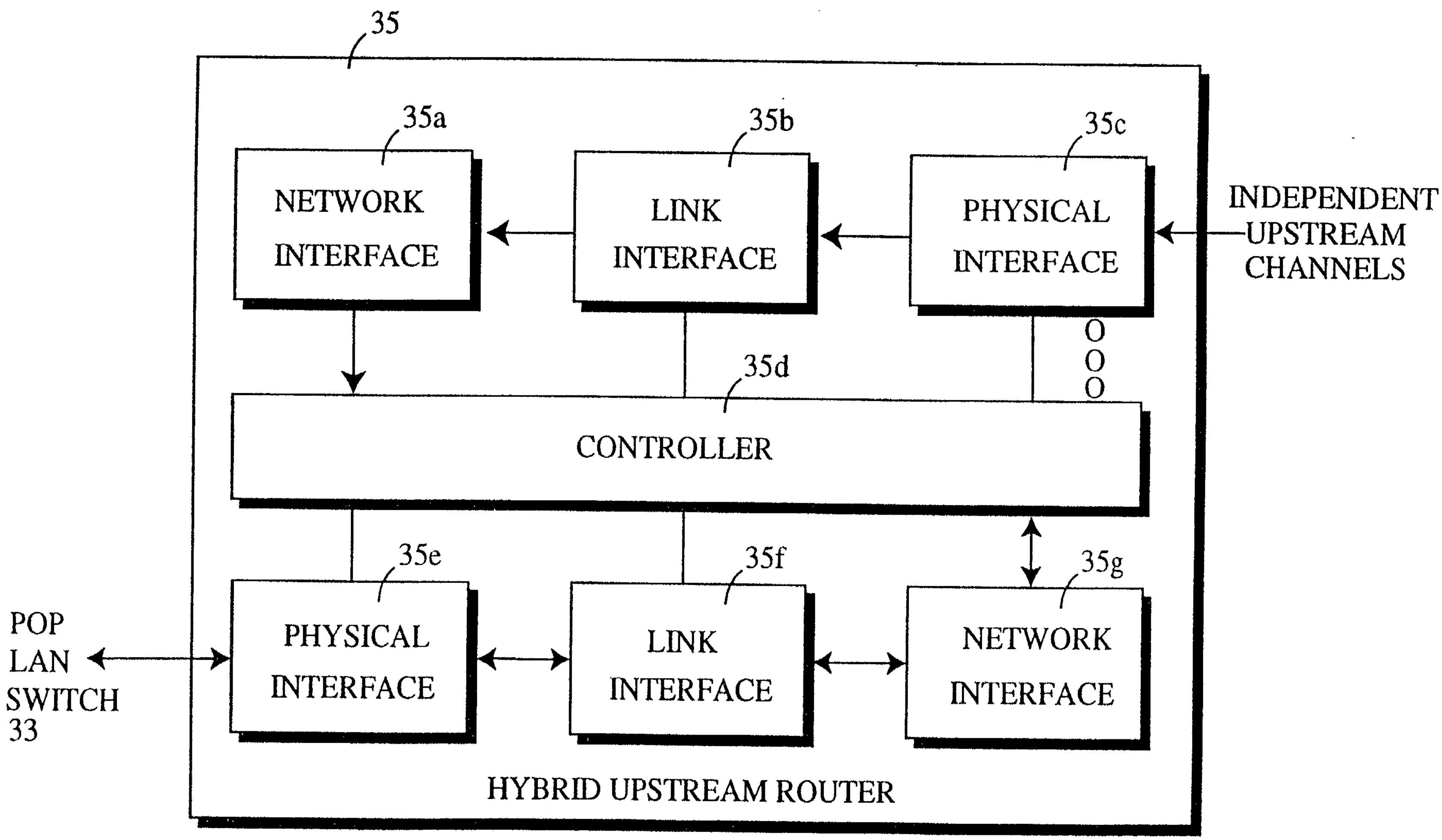

35
35a
NETWORK INTERFACE
35b
LINK INTERFACE
35c
PHYSICAL INTERFACE
INDEPENDENT UPSTREAM CHANNELS
35d
CONTROLLER
35e
PHYSICAL INTERFACE
35f
LINK INTERFACE
35g
NETWORK INTERFACE
POP LAN SWITCH 33
HYBRID UPSTREAM ROUTER

FIGURE 2c

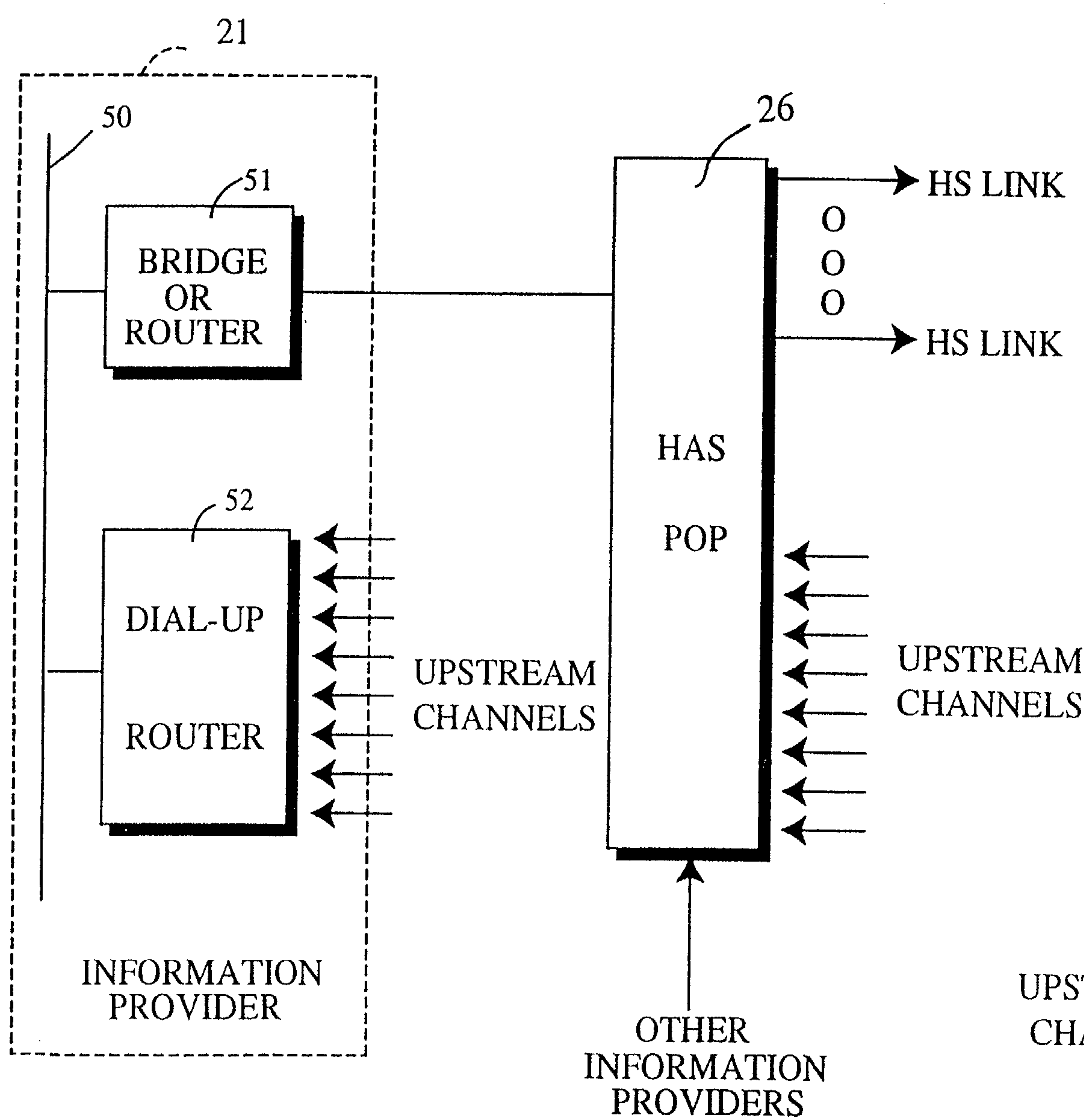


FIGURE 3a

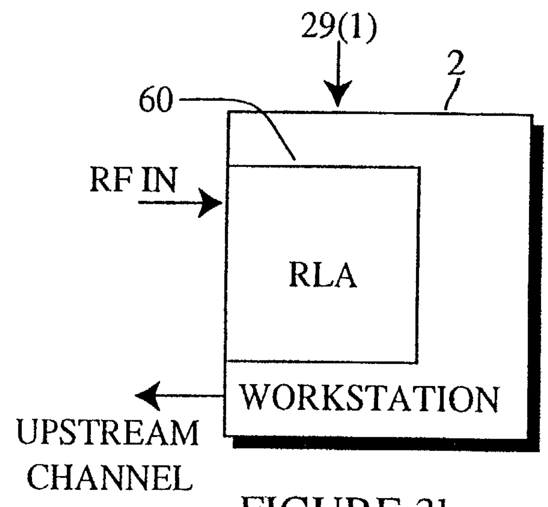


FIGURE 3b

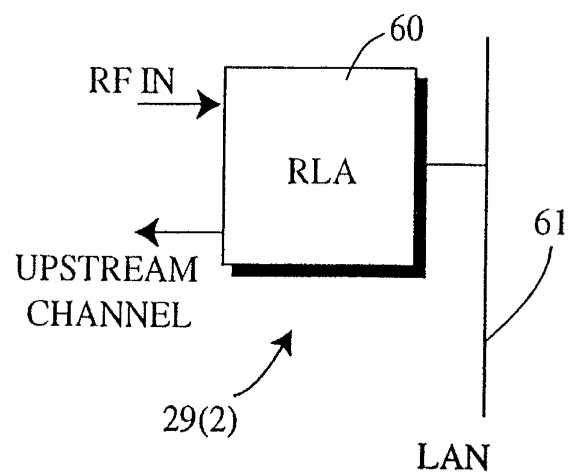


FIGURE 3c

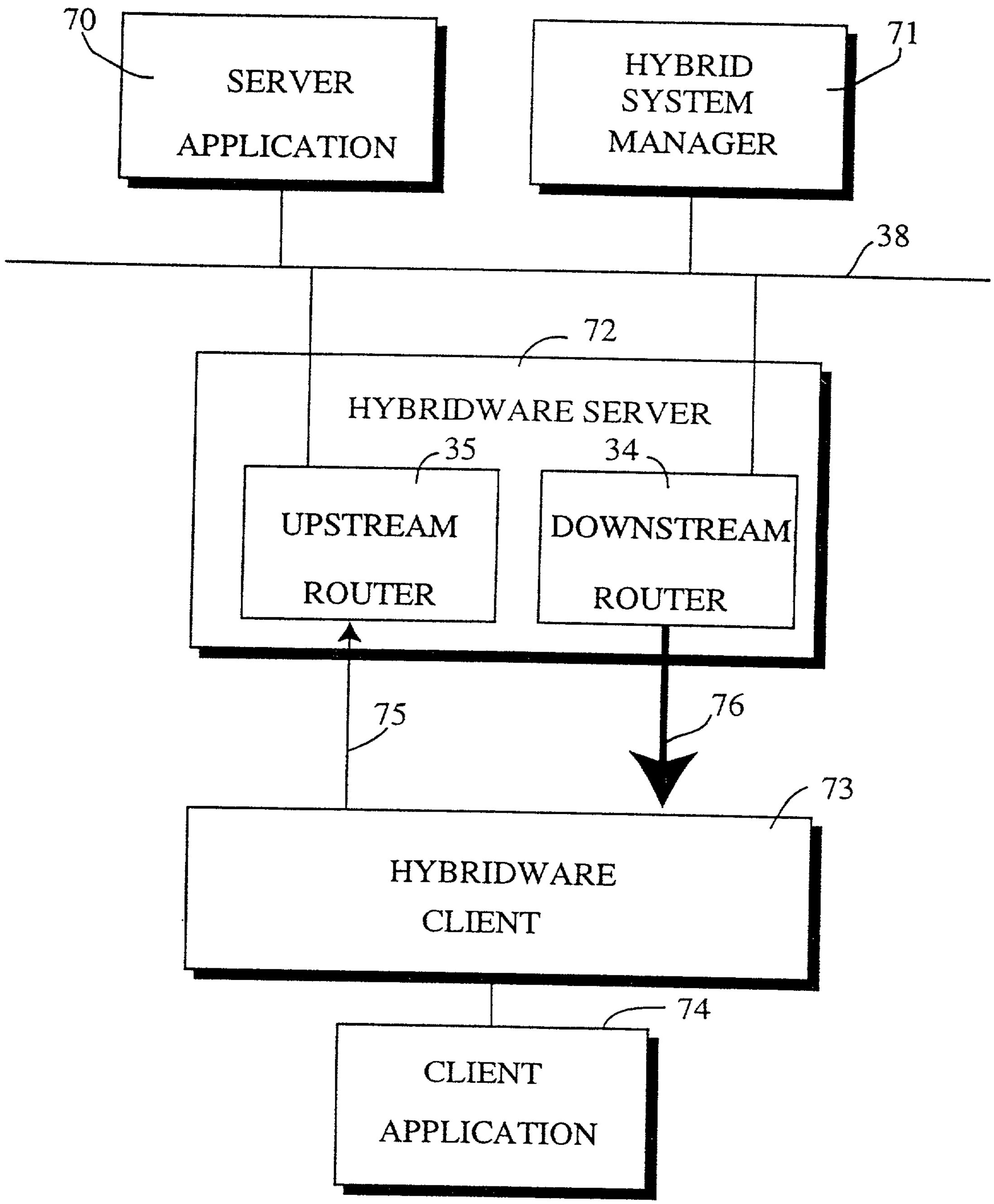

70
SERVER
APPLICATION
HYBRID
SYSTEM
MANAGER
71
38
72
HYBRIDWARE SERVER
35
34
UPSTREAM
ROUTER
DOWNSTREAM
ROUTER
75
76
73
HYBRIDWARE
CLIENT
74
CLIENT
APPLICATION

FIGURE 4

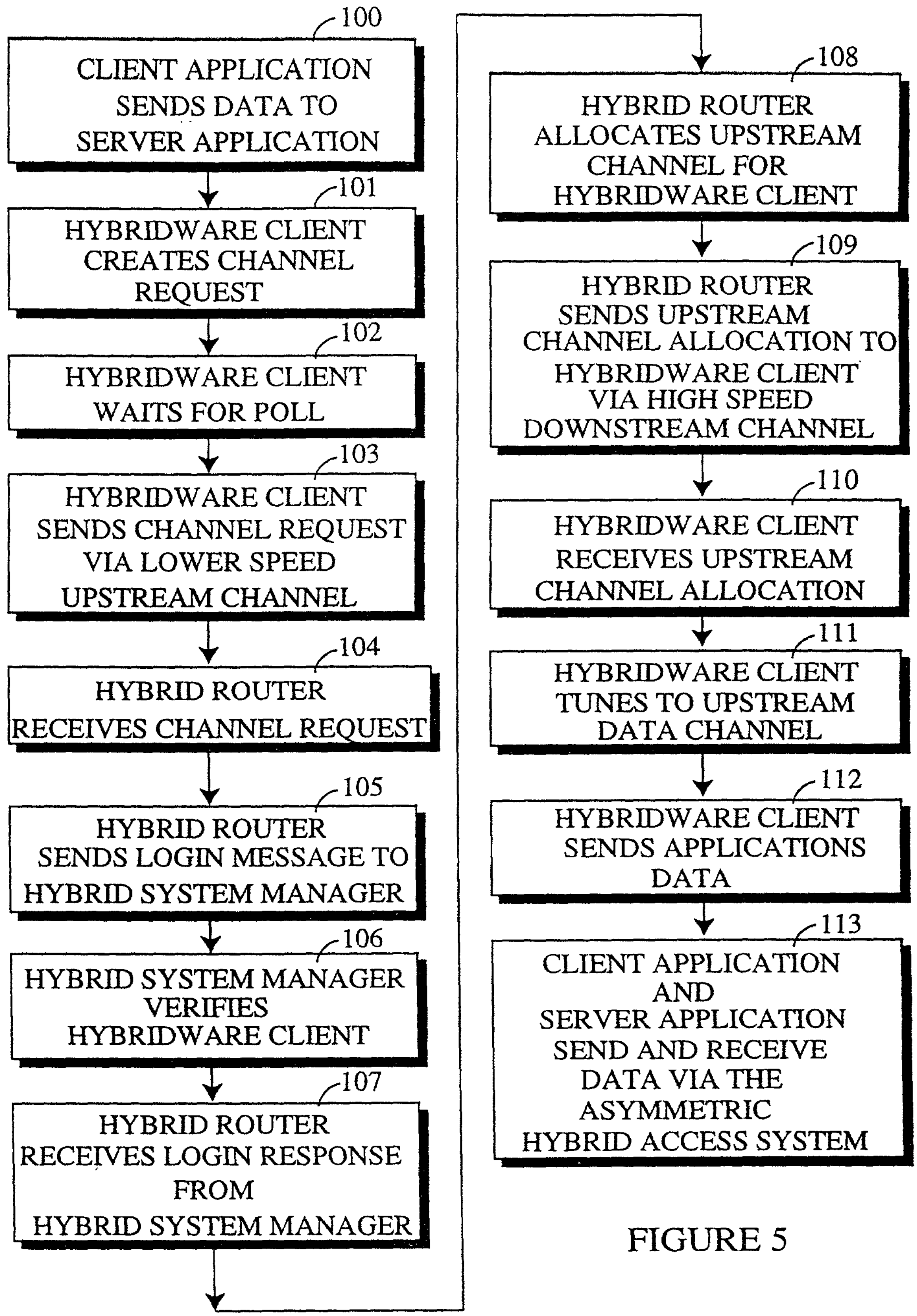

100
CLIENT APPLICATION SENDS DATA TO SERVER APPLICATION
101
HYBRIDWARE CLIENT CREATES CHANNEL REQUEST
102
HYBRIDWARE CLIENT WAITS FOR POLL
103
HYBRIDWARE CLIENT SENDS CHANNEL REQUEST VIA LOWER SPEED UPSTREAM CHANNEL
104
HYBRID ROUTER RECEIVES CHANNEL REQUEST
105
HYBRID ROUTER SENDS LOGIN MESSAGE TO HYBRID SYSTEM MANAGER
106
HYBRID SYSTEM MANAGER VERIFIES HYBRIDWARE CLIENT
107
HYBRID ROUTER RECEIVES LOGIN RESPONSE FROM HYBRID SYSTEM MANAGER
108
HYBRID ROUTER ALLOCATES UPSTREAM CHANNEL FOR HYBRIDWARE CLIENT
109
HYBRID ROUTER SENDS UPSTREAM CHANNEL ALLOCATION TO HYBRIDWARE CLIENT VIA HIGH SPEED DOWNSTREAM CHANNEL
110
HYBRIDWARE CLIENT RECEIVES UPSTREAM CHANNEL ALLOCATION
111
HYBRIDWARE CLIENT TUNES TO UPSTREAM DATA CHANNEL
112
HYBRIDWARE CLIENT SENDS APPLICATIONS DATA
113
CLIENT APPLICATION AND SERVER APPLICATION SEND AND RECEIVE DATA VIA THE ASYMMETRIC HYBRID ACCESS SYSTEM

FIGURE 5

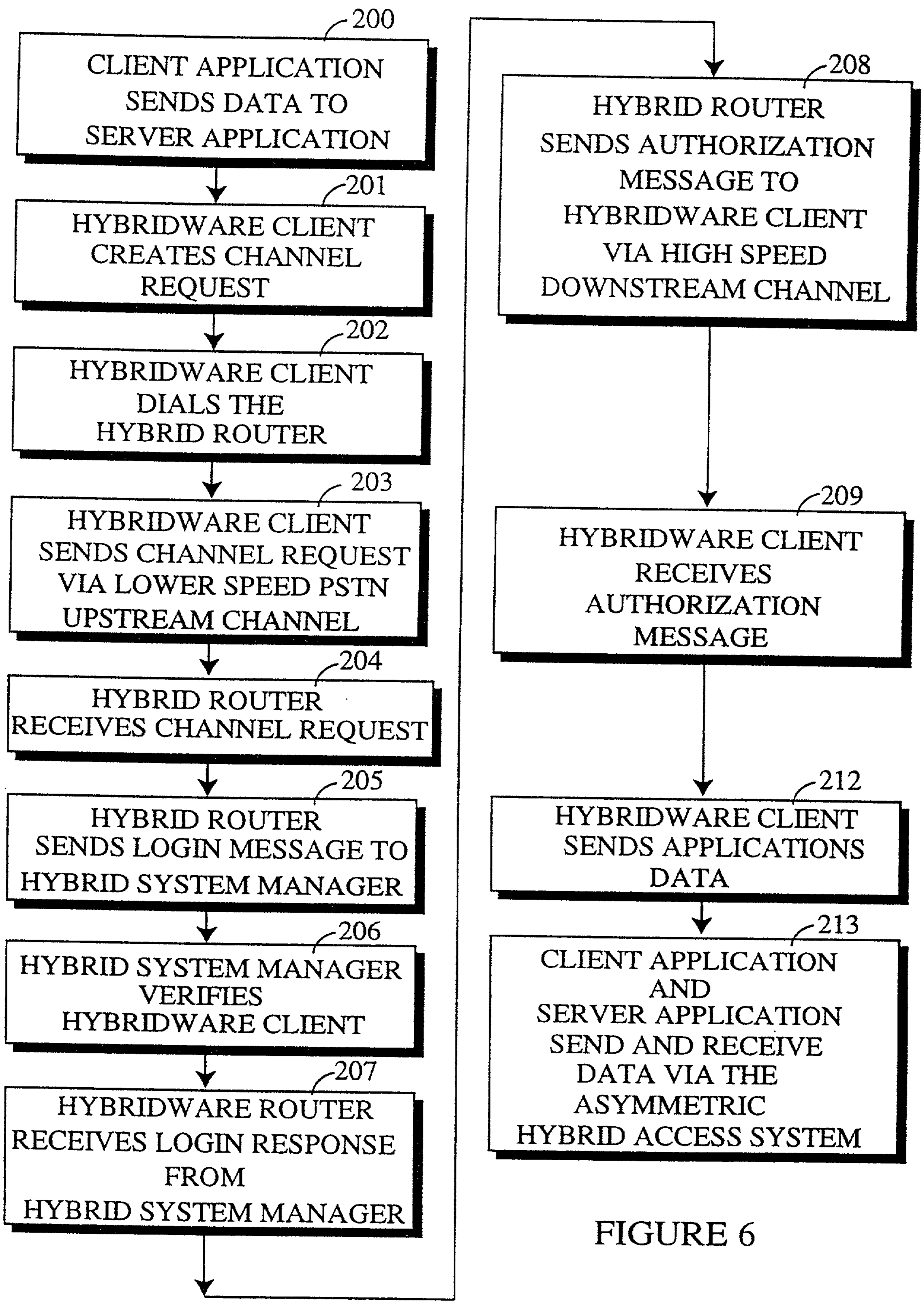

200
CLIENT APPLICATION SENDS DATA TO SERVER APPLICATION
201
HYBRIDWARE CLIENT CREATES CHANNEL REQUEST
202
HYBRIDWARE CLIENT DIALS THE HYBRID ROUTER
203
HYBRIDWARE CLIENT SENDS CHANNEL REQUEST VIA LOWER SPEED PSTN UPSTREAM CHANNEL
204
HYBRID ROUTER RECEIVES CHANNEL REQUEST
205
HYBRID ROUTER SENDS LOGIN MESSAGE TO HYBRID SYSTEM MANAGER
206
HYBRID SYSTEM MANAGER VERIFIES HYBRIDWARE CLIENT
207
HYBRIDWARE ROUTER RECEIVES LOGIN RESPONSE FROM HYBRID SYSTEM MANAGER
208
HYBRID ROUTER SENDS AUTHORIZATION MESSAGE TO HYBRIDWARE CLIENT VIA HIGH SPEED DOWNSTREAM CHANNEL
209
HYBRIDWARE CLIENT RECEIVES AUTHORIZATION MESSAGE
212
HYBRIDWARE CLIENT SENDS APPLICATIONS DATA
213
CLIENT APPLICATION AND SERVER APPLICATION SEND AND RECEIVE DATA VIA THE ASYMMETRIC HYBRID ACCESS SYSTEM

FIGURE 6

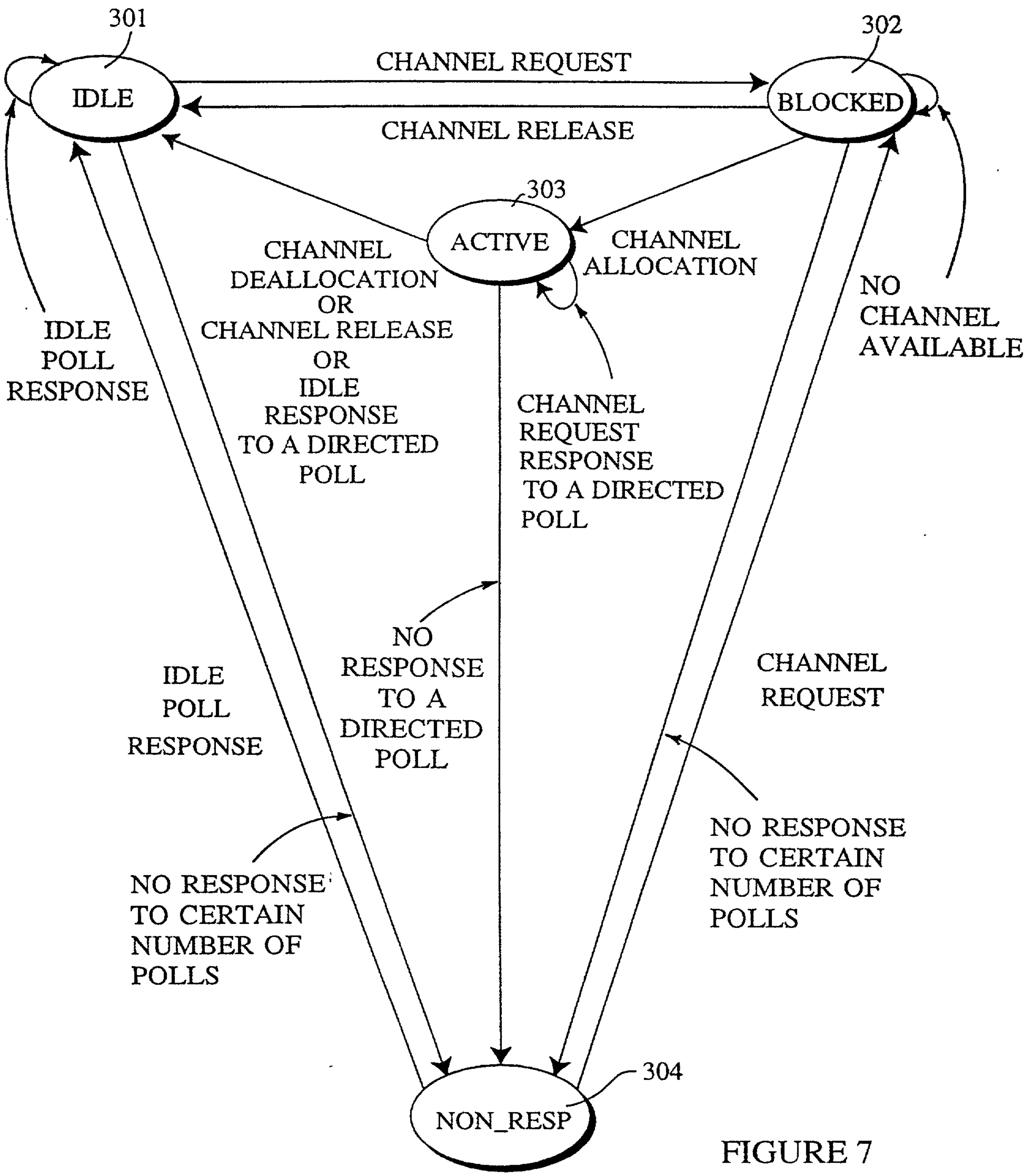

301
302
303
304
IDLE
BLOCKED
ACTIVE
NON_RESP
CHANNEL REQUEST
CHANNEL RELEASE
CHANNEL DEALLOCATION OR CHANNEL RELEASE OR IDLE RESPONSE TO A DIRECTED POLL
CHANNEL ALLOCATION
NO CHANNEL AVAILABLE
IDLE POLL RESPONSE
CHANNEL REQUEST RESPONSE TO A DIRECTED POLL
NO RESPONSE TO A DIRECTED POLL
IDLE POLL RESPONSE
CHANNEL REQUEST
NO RESPONSE TO CERTAIN NUMBER OF POLLS
NO RESPONSE TO CERTAIN NUMBER OF POLLS

FIGURE 7

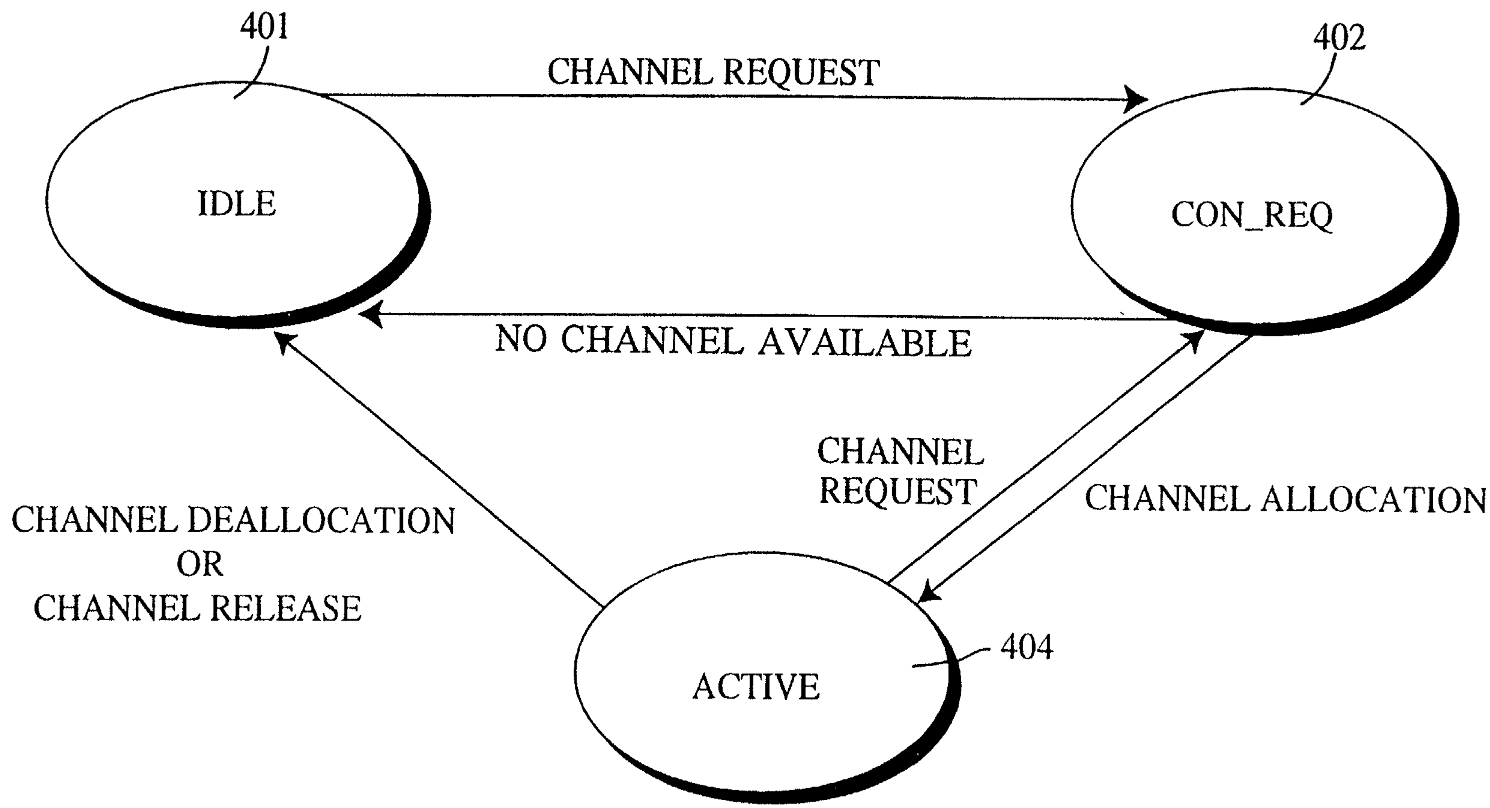

401
CHANNEL REQUEST
402
IDLE
CON_REQ
NO CHANNEL AVAILABLE
CHANNEL
REQUEST
CHANNEL ALLOCATION
CHANNEL DEALLOCATION
OR
CHANNEL RELEASE
404
ACTIVE

FIGURE 8

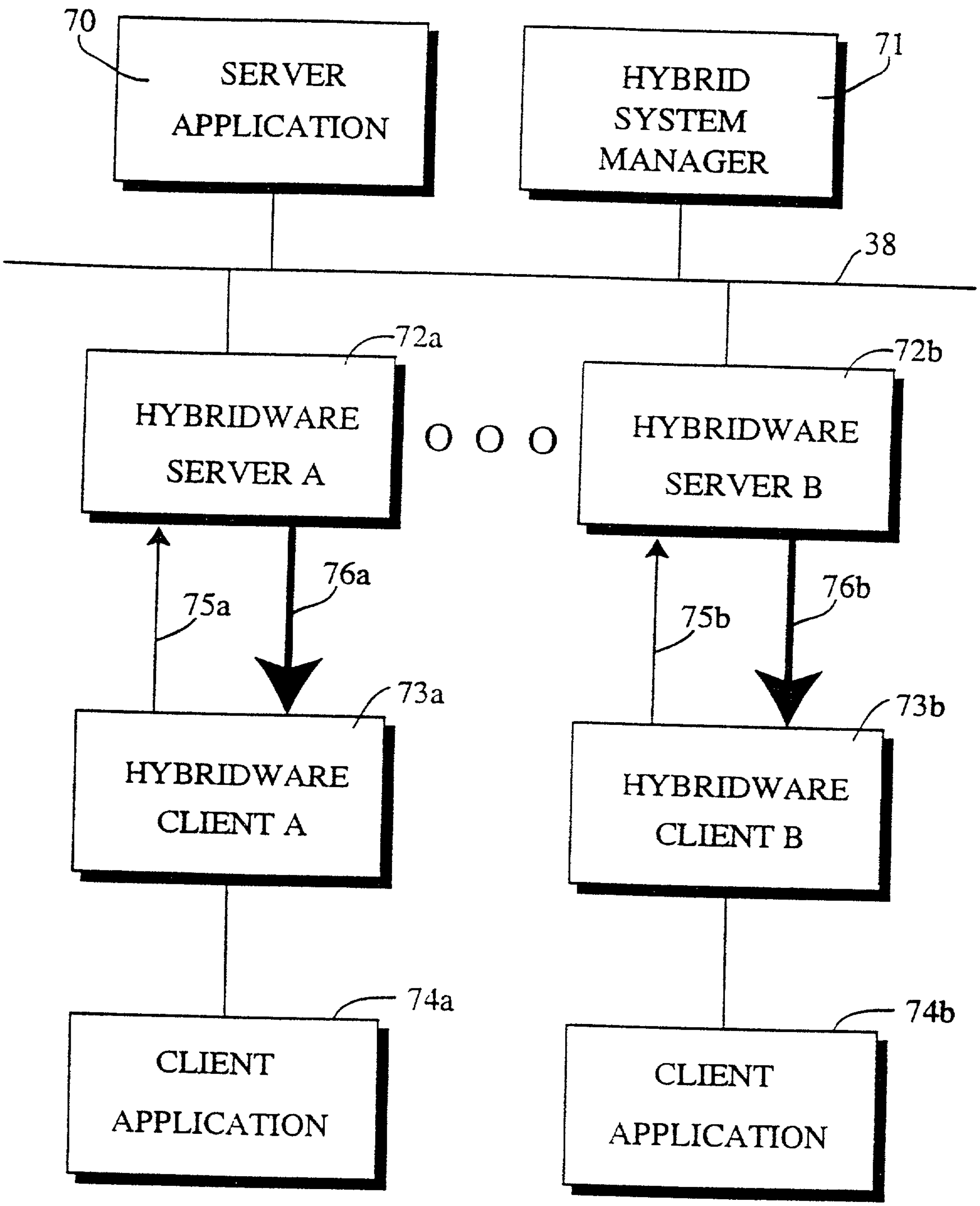

70
SERVER APPLICATION
HYBRID SYSTEM MANAGER
71
38
72a
HYBRIDWARE SERVER A
O O O
72b
HYBRIDWARE SERVER B
76a
75a
76b
75b
73a
HYBRIDWARE CLIENT A
73b
HYBRIDWARE CLIENT B
74a
CLIENT APPLICATION
74b
CLIENT APPLICATION

FIGURE 9

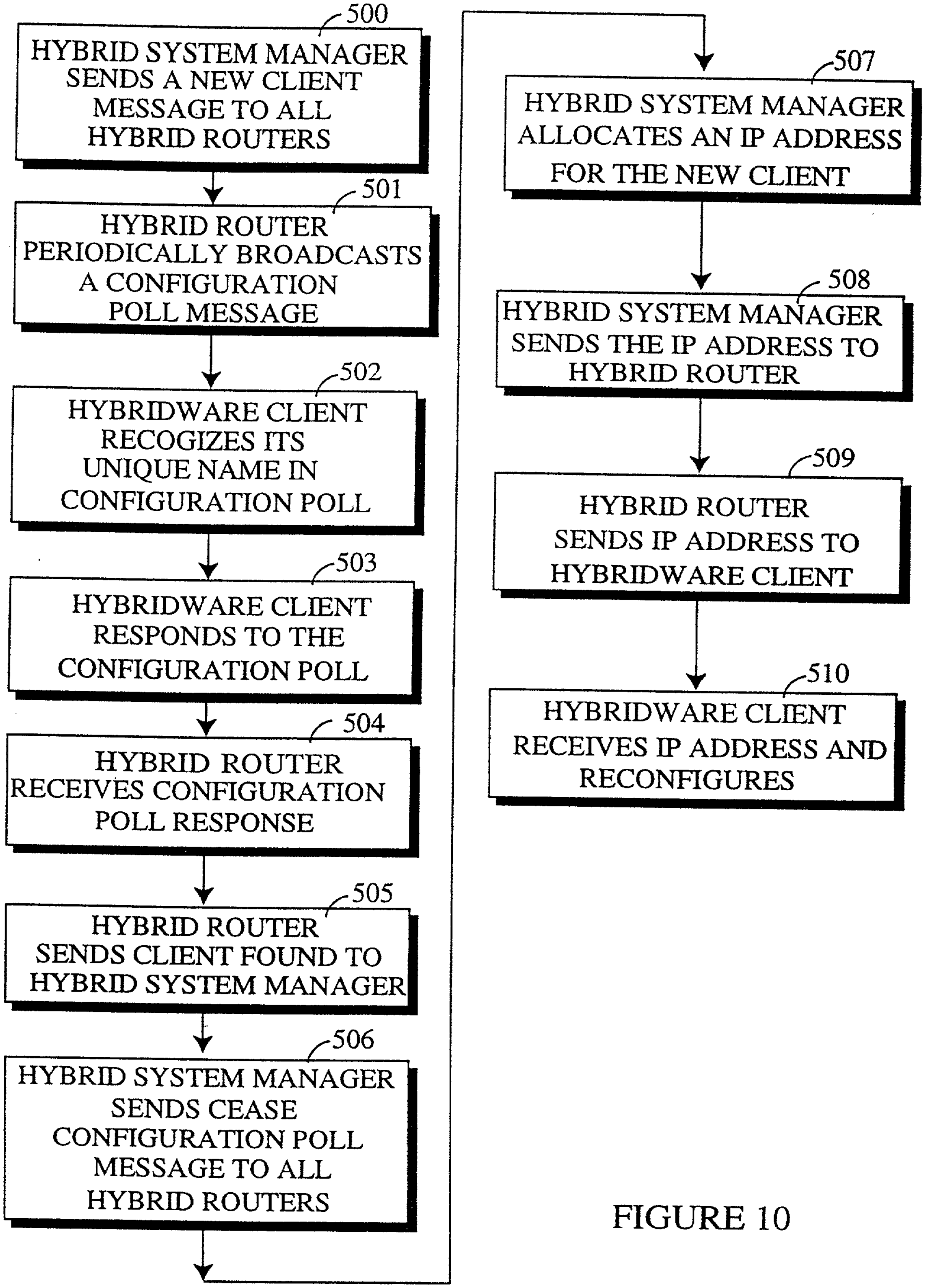

500
HYBRID SYSTEM MANAGER SENDS A NEW CLIENT MESSAGE TO ALL HYBRID ROUTERS
501
HYBRID ROUTER PERIODICALLY BROADCASTS A CONFIGURATION POLL MESSAGE
502
HYBRIDWARE CLIENT RECOGIZES ITS UNIQUE NAME IN CONFIGURATION POLL
503
HYBRIDWARE CLIENT RESPONDS TO THE CONFIGURATION POLL
504
HYBRID ROUTER RECEIVES CONFIGURATION POLL RESPONSE
505
HYBRID ROUTER SENDS CLIENT FOUND TO HYBRID SYSTEM MANAGER
506
HYBRID SYSTEM MANAGER SENDS CEASE CONFIGURATION POLL MESSAGE TO ALL HYBRID ROUTERS
507
HYBRID SYSTEM MANAGER ALLOCATES AN IP ADDRESS FOR THE NEW CLIENT
508
HYBRID SYSTEM MANAGER SENDS THE IP ADDRESS TO HYBRID ROUTER
509
HYBRID ROUTER SENDS IP ADDRESS TO HYBRIDWARE CLIENT
510
HYBRIDWARE CLIENT RECEIVES IP ADDRESS AND RECONFIGURES

FIGURE 10

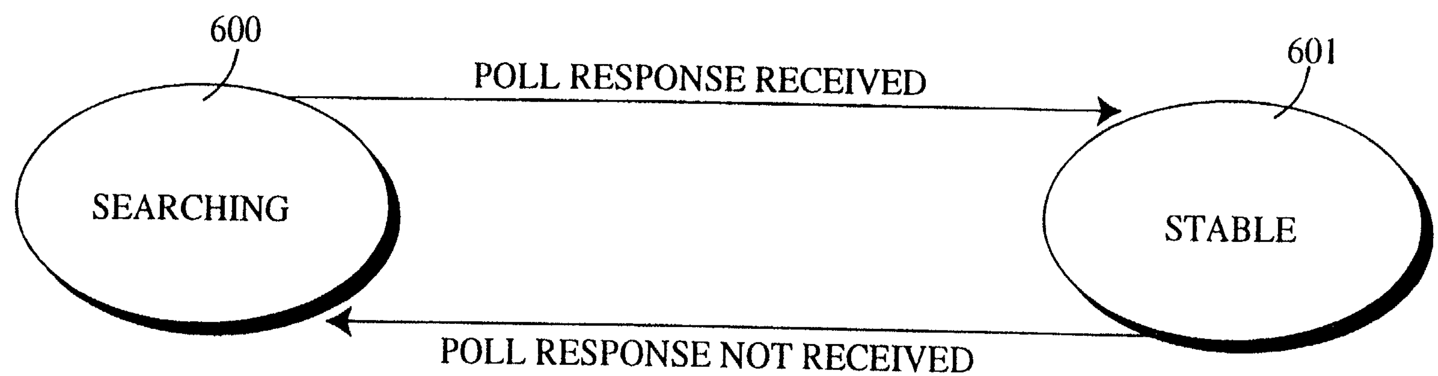

600
601
POLL RESPONSE RECEIVED
SEARCHING
STABLE
POLL RESPONSE NOT RECEIVED

FIGURE 11

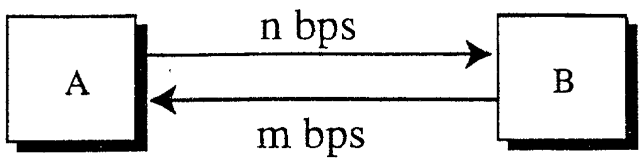


FIGURE 12a
PRIOR ART

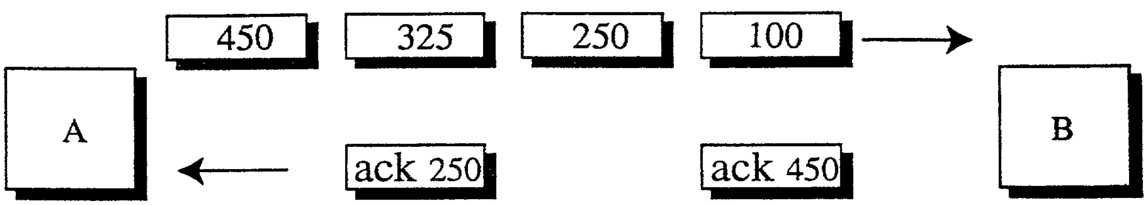


FIGURE 12b
PRIOR ART

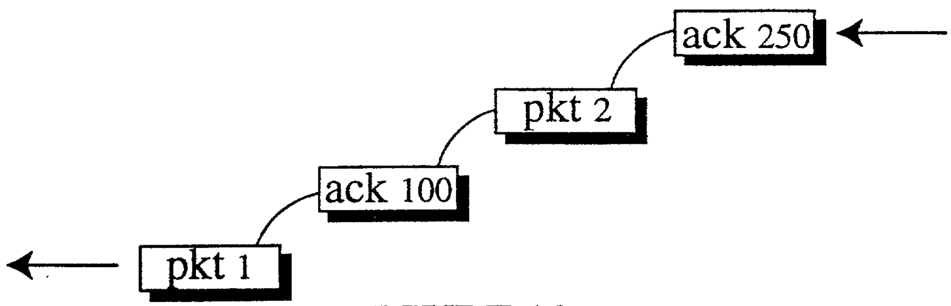


FIGURE 12c

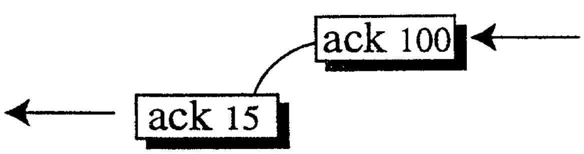


FIGURE 12d

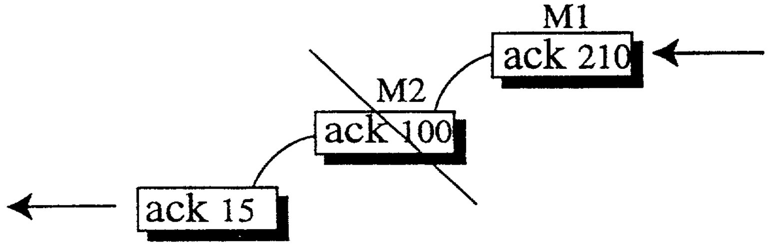


FIGURE 12e

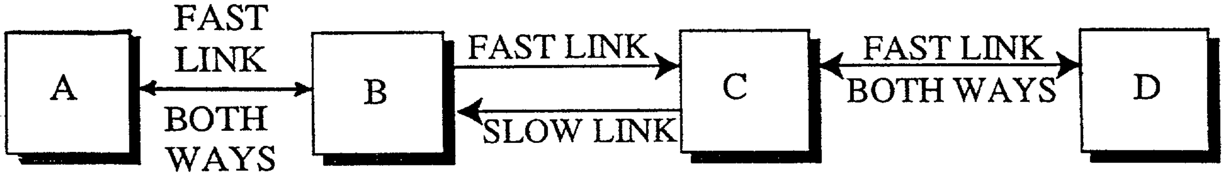
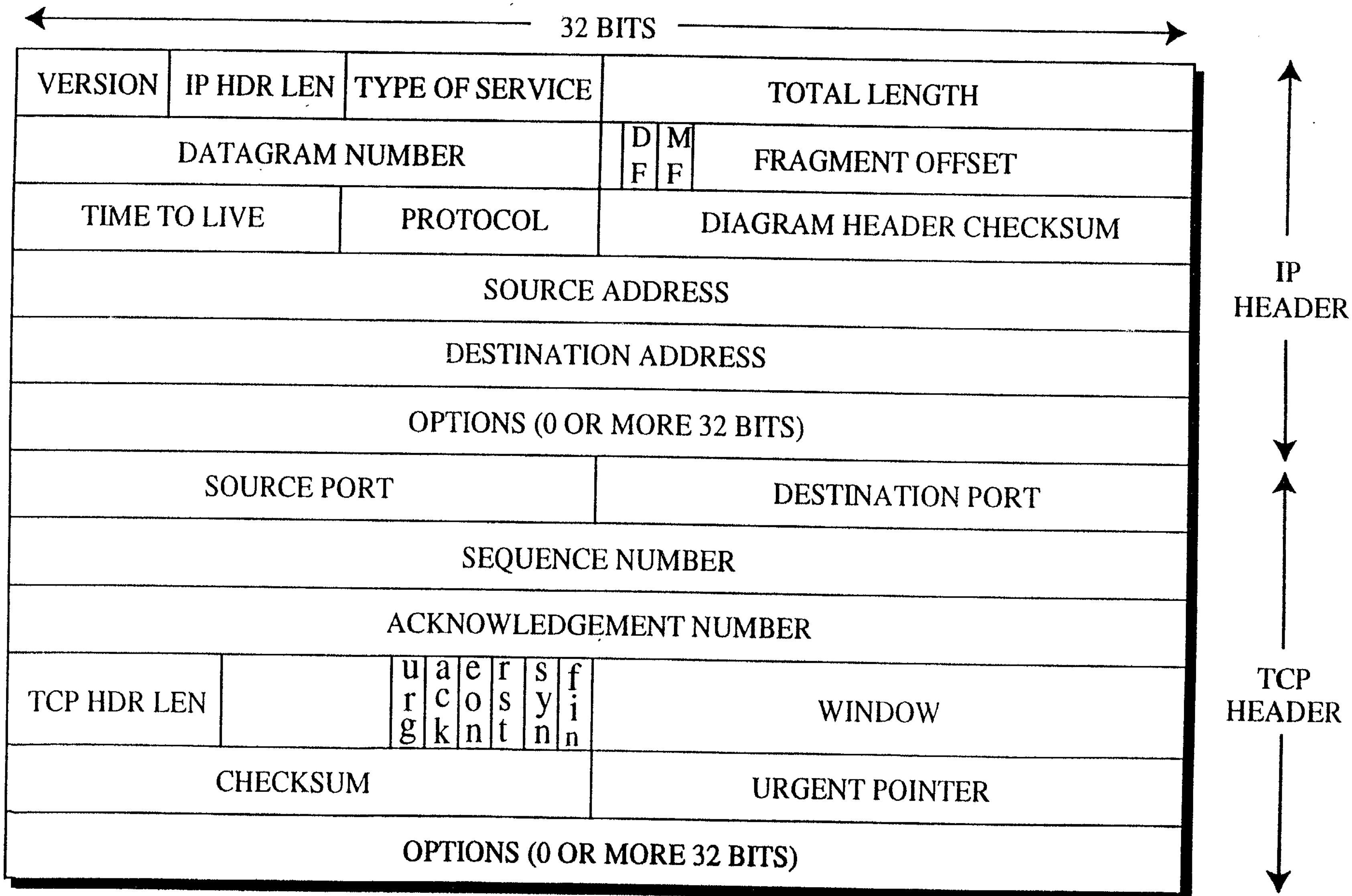


FIGURE 12f



32 BITS
VERSION
IP HDR LEN
TYPE OF SERVICE
TOTAL LENGTH
DATAGRAM NUMBER
D F
M F
FRAGMENT OFFSET
TIME TO LIVE
PROTOCOL
DIAGRAM HEADER CHECKSUM
SOURCE ADDRESS
DESTINATION ADDRESS
OPTIONS (0 OR MORE 32 BITS)
SOURCE PORT
DESTINATION PORT
SEQUENCE NUMBER
ACKNOWLEDGEMENT NUMBER
TCP HDR LEN
urg
ack
eon
rst
syn
fin
WINDOW
CHECKSUM
URGENT POINTER
OPTIONS (0 OR MORE 32 BITS)
IP HEADER
TCP HEADER

FIGURE 13

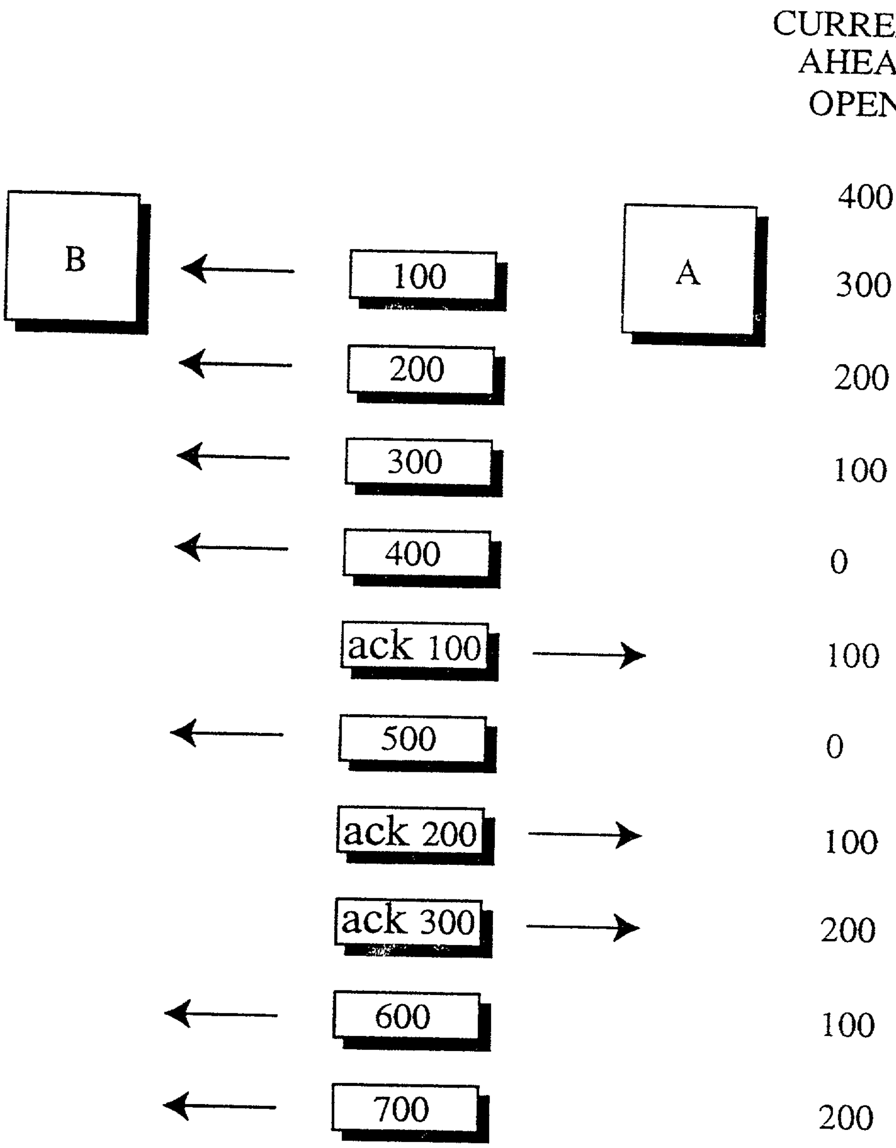


FIGURE 14a

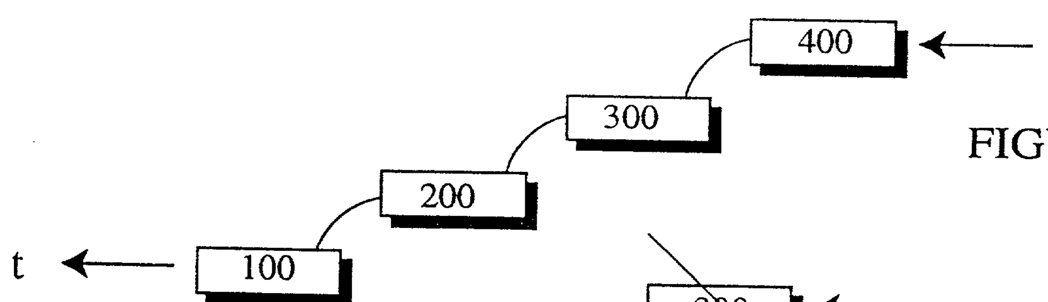


FIGURE 14b

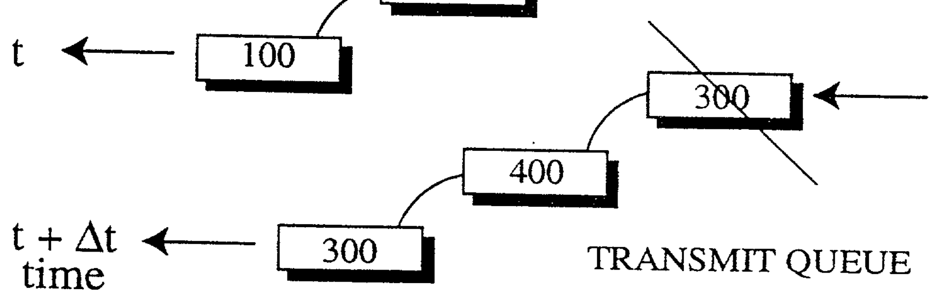


FIGURE 14c

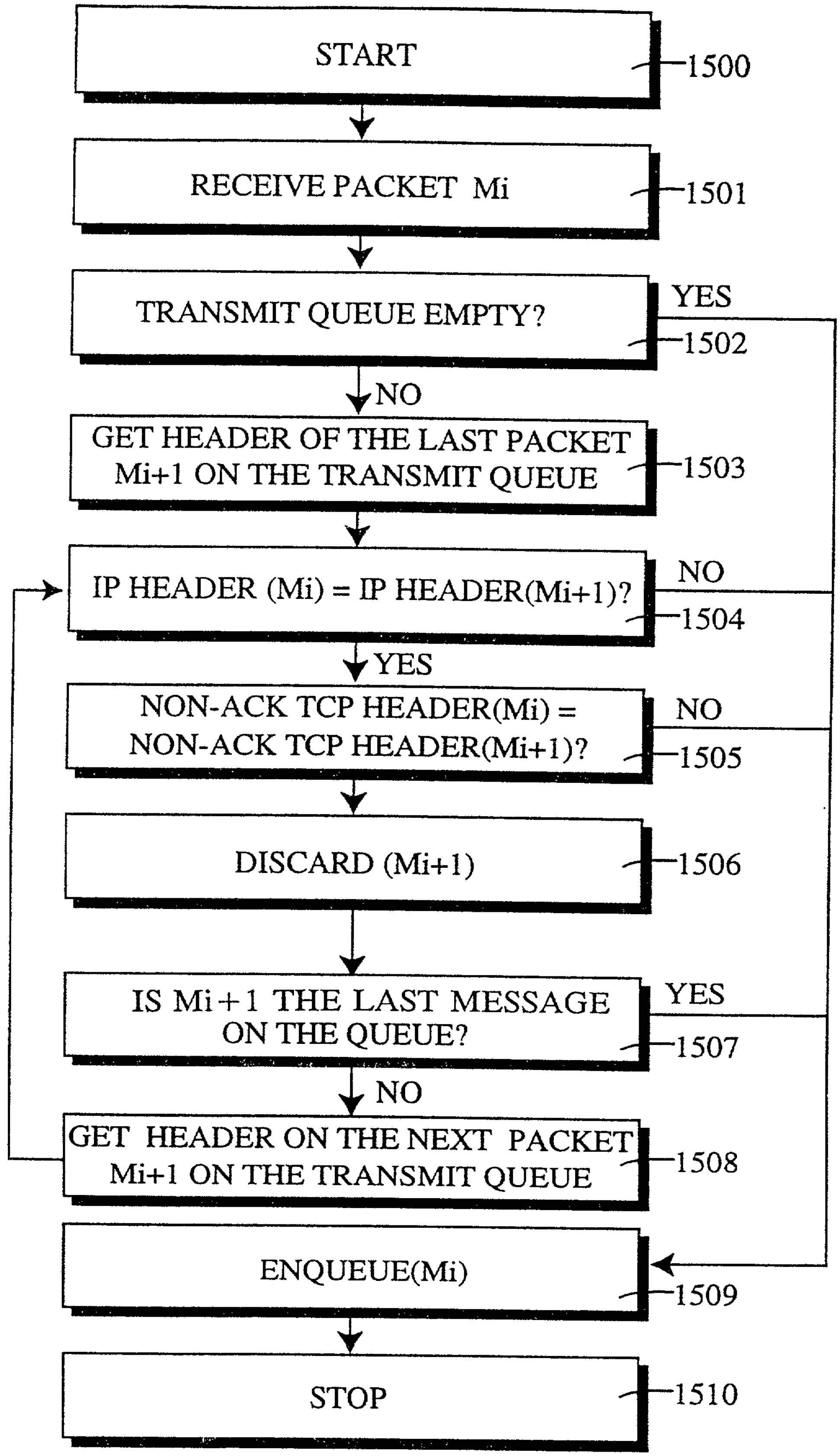

START
1500
RECEIVE PACKET Mi
1501
TRANSMIT QUEUE EMPTY?
YES
1502
NO
GET HEADER OF THE LAST PACKET Mi+1 ON THE TRANSMIT QUEUE
1503
IP HEADER (Mi) = IP HEADER(Mi+1)?
NO
1504
YES
NON-ACK TCP HEADER(Mi) = NON-ACK TCP HEADER(Mi+1)?
NO
1505
DISCARD (Mi+1)
1506
IS Mi+1 THE LAST MESSAGE ON THE QUEUE?
YES
1507
NO
GET HEADER ON THE NEXT PACKET Mi+1 ON THE TRANSMIT QUEUE
1508
ENQUEUE(Mi)
1509
STOP
1510

FIGURE 15

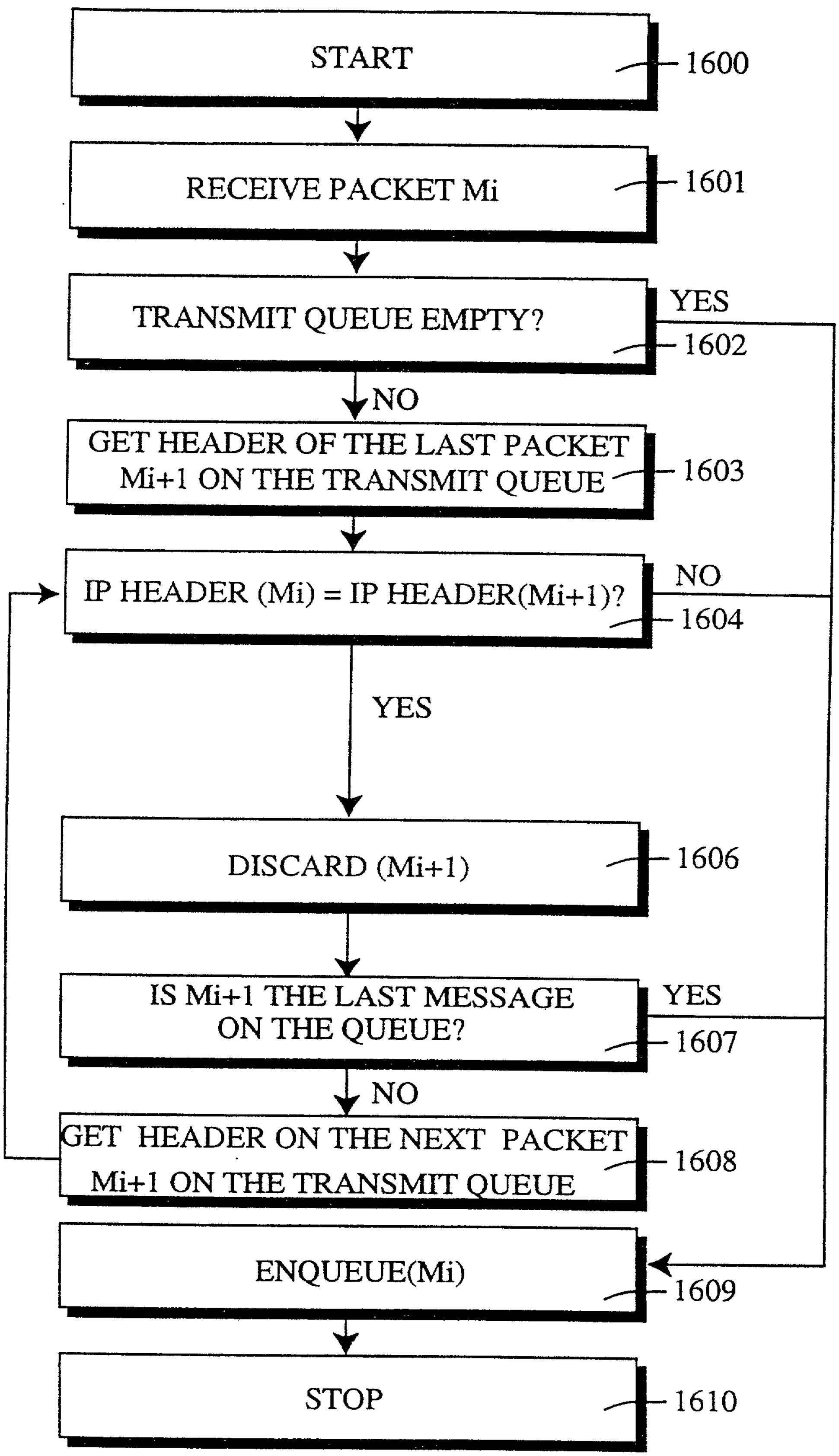

START
1600
RECEIVE PACKET Mi
1601
TRANSMIT QUEUE EMPTY?
YES
1602
NO
GET HEADER OF THE LAST PACKET Mi+1 ON THE TRANSMIT QUEUE
1603
IP HEADER (Mi) = IP HEADER(Mi+1)?
NO
1604
YES
DISCARD (Mi+1)
1606
IS Mi+1 THE LAST MESSAGE ON THE QUEUE?
YES
1607
NO
GET HEADER ON THE NEXT PACKET Mi+1 ON THE TRANSMIT QUEUE
1608
ENQUEUE(Mi)
1609
STOP
1610

FIGURE 16

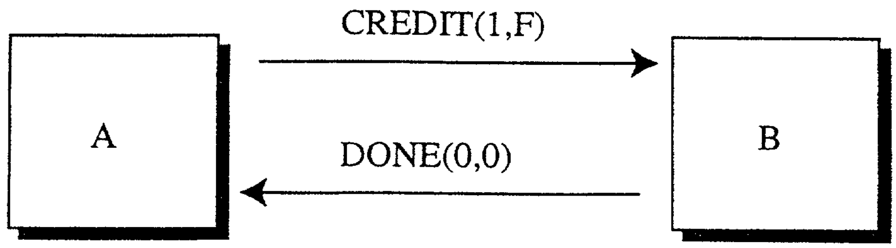


FIGURE 17

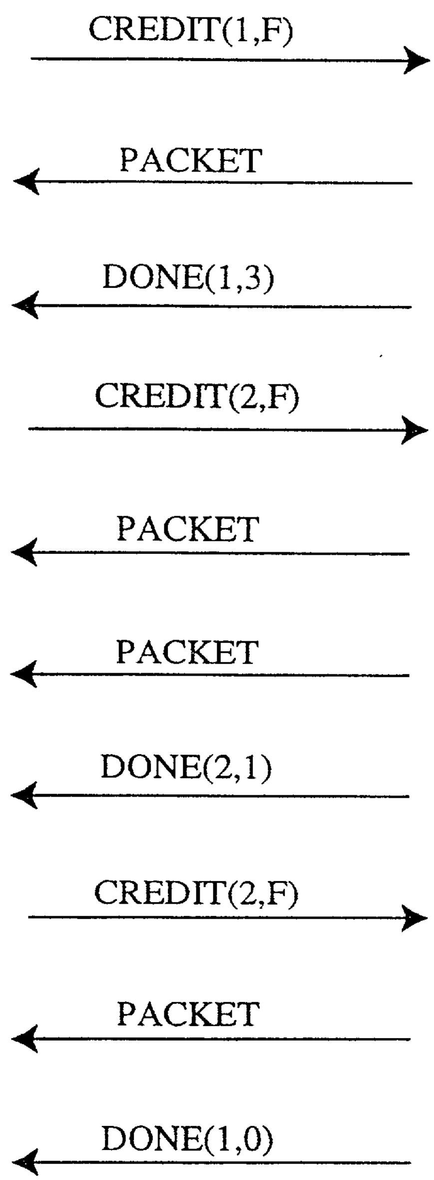


FIGURE 18

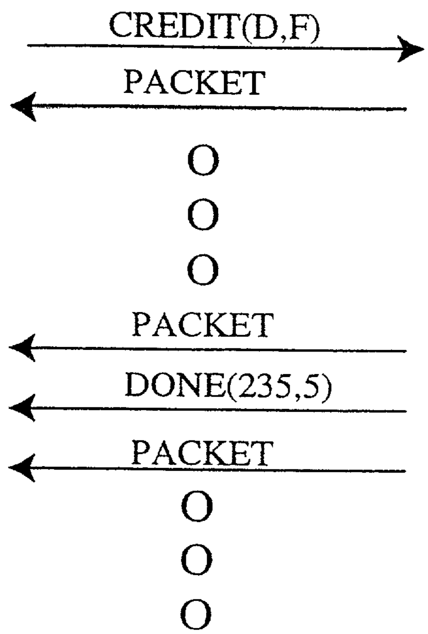


FIGURE 19

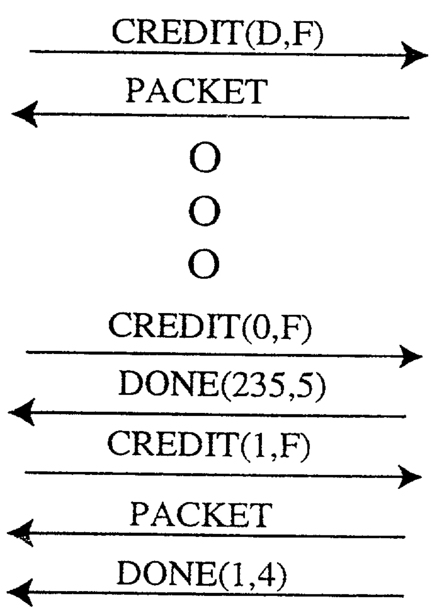


FIGURE 20

Attorney Docket No. 27459-803/767

DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that: my residence, post office address and citizenship are as stated below next to my name; that I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter that is claimed and for which a patent is sought on the invention entitled: ASYMMETRIC HYBRID ACCESS SYSTEM AND METHOD, the specification of which was filed on August 27, 1996 as Application Serial No. 08/703,767.

I hereby state that I have reviewed and understand that contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information that is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, § 1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application or patent or inventor's certificate having a filing dated before that of the application of which priority is claimed:

Country	Application Number	Date of Filing	Priority Claimed Under 35 U.S.C. 119

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) listed below and, in so far as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code § 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, § 1.56(a) that occurred between the filing date of the prior application and the national or PCT international filing dated of this application:

Application Number	Date of Filing	Status (patented, pending, abandoned)

I hereby appoint the following attorney to prosecute this application and transact all business in the Patent and Trademark Office connected therewith: Lawrence Harbin, Reg. No. 27644, Farkas & Manelli, PLLC, 1233 20th Street, NW, Suite 700, Washington, DC 20036 whose telephone number is (202)778-1139 (to whom all communications are to be directed to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith and with the resulting patent).

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that any such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

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